

PBEEEP

State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for Century College



1/18/2012

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Screening Report

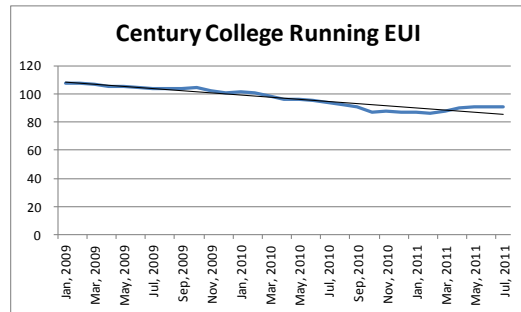
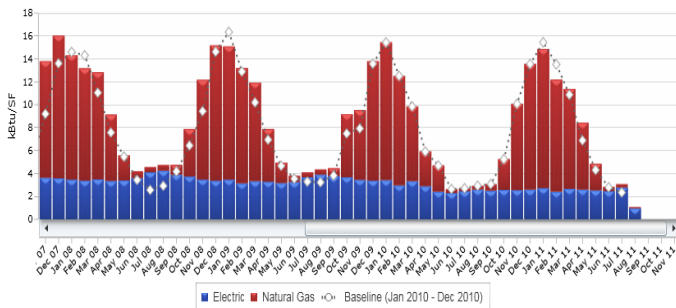


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Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Century College was performed by Hallberg Engineering, Inc. This report is the result of that information.

Payback Information and Energy Savings			
Total Project costs (Without Co-funding)		Project costs with Co-funding	
Total costs to date including study	\$129,030	Total Project Cost	\$171,490
Future costs including Implementation , Measurement & Verification	\$42,460	Study and Administrative Cost Paid with ARRA Funds	(\$135,030)
Total Project Cost	\$171,490	Xcel Energy Rebates	(\$77,470)
		Total costs after co-funding	(\$41,010)
Estimated Annual Total Savings (\$)	\$35,730	Estimated Annual Total Savings (\$)	\$35,730
Total Project Payback	4.8	Total Project Payback with co-funding	Less than 0
Electric Energy Savings		5.5% and Gas Energy Savings	5.7%



Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost \$	Average Cost Rate \$ /kBtu
2009	365	732,094	74,880,043	68,824,972	6,055,071	9%	\$1,009,154.70	\$0.01
2010	365	732,094	64,924,194	64,924,194	0	0%	\$941,013.42	\$0.01
2011	212	732,094	42,988,650	42,923,127	65,523	0%	\$628,635.15	\$0.01

Century College Consumption Report

The energy use at century College dropped approximately 9% over the period of the investigation.



Summary Tables

Facility Name	Century College
Location	3300 Century Ave N (East Buildings) 3401 Century Ave N (West Buildings) White Bear Lake, MN 55110
Facility Manager	Gregg Gramse
Number of Buildings Investigated	13 (By State ID #'s); 4 for Report
Interior Square Footage Investigated	677,031
PBEEEP Provider	Hallberg Engineering
Study Period	Fall 2010 through Spring 2011
Site Project Manager	Ron Fields
Annual Energy Cost	\$941,013 (2010)
Utility Company	Xcel Energy (electricity and natural gas)
Site Energy Use Index (EUI)	91 kBtu/sq.ft (end of study)
Benchmark EUI (from B3)	130 kBtu/sq. ft

Buildings Investigated:

The thirteen buildings listed below totaling 677,031 interior square feet at Century College were investigated.

Building Name	State ID's Included	Area (Square Feet)	Year Built
West Campus Buildings	E26154C0168, 269, 371, 474, 577, 690, 790, 890	260,107	1968, 1969, 1971, 1974, 1977, 1990
Kopp Technology Center	E26154C0903	22,600	2003
Library/Science Building	E26210T1508	66,930	2008
East Campus Buildings	E26210T0171, 574, 676	327,394	1971, 1974, 1976

Mechanical Equipment Included in Investigation: Summary Table	
1	UHL (Niagara) Building Automation System (controls all buildings)
13	Buildings, 4 main building groups (East, West, Kopp, Library/Science)
677,031	Square Feet Investigated
63	Air Handlers (incl. the two still under warranty)
1	Rooftop Units
83	VAV Boxes
9	CRAC Units
2	Chillers
1	Cooling Tower
2	Steam Boilers
2	Hot Water Boilers

Implementation Information			
Estimated Annual Total Savings (\$)		3.8% Savings	\$35,730
Total Estimated Implementation Cost (\$)			\$36,460
GHG Avoided in U.S Tons (CO2e)			409
Electric Energy Savings (kWh) (2010 Usage 6,972,440 kWh)		5.5% Savings	382,713
Gas Energy Savings (Therms) (2010 Usage was 400,850 Therms)		5.7% Savings	23,022
Statistics			
Number of Measures identified			15
Number of Measures with payback < 3 years			5
Screening Start Date	01/25/2010	Screening End Date	04/5/2010
Investigation Start Date	08/10/2010	Investigation End Date	7/26/2011
Final Report	12/1/2011	Report with Rebates	1/18/2012

Century College Cost Information			
Phase		To date	Estimated Future Cost
Screening		\$10,121	
Investigation [Provider]		\$100,000	
Investigation [CEE]		\$18,909	\$1,000
Implementation			\$36,460
Implementation [CEE]			\$2,500
Measurement & Verification			\$2,500
Total		\$129,030	\$42,460

Co-funding Summary	
Study and Administrative Cost	\$135,030
Utility Co-Funding - Estimated Total (\$)	\$77,470
Total Co-funding (\$)	\$212,500

Century College Overview

The energy investigation identified 5.6% of total energy savings at Century College with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Century College adjusting equipment schedules to match actual occupancy period in buildings, optimizing economizer operations and optimizing the chilled water system at the East campus by implementing a control sequence that utilizes the existing parallel pumping arrangement and adds a chilled water reset. The total cost of implementing all the measures is \$36,460.

Implementing all these measures can save the facility approximately \$34,661 a year. Because the study was paid for with ARRA funds and there are also rebates from Xcel Energy, Century College is eligible to receive \$212,500 in co-funding, \$41,010 more than the direct costs of the energy investigation and implementation of energy saving measures.

In addition to the 5.6% savings that these measures will lead to, we note that during the period of the PBEEEP investigation energy use at Century College decreased 9% compared to the year prior to the study. It is now 30% below the benchmark value according to the Minnesota Benchmarking and Beyond database (B3).

The site is made up of two campuses, West Campus and East Campus, each of which contains a number of buildings. The West Campus is composed of eight interconnected buildings totaling 260,107 interior square feet. The East Campus is composed of one main building with three additions totaling 329,794 interior square feet. The East Campus is attached by enclosed hallways to the Kopp Center, 22,600 interior square feet, and the Library/Science Building, 66,390 interior square feet. There is a single automation system (UHL) which controls the large buildings on both campuses, but none of the satellite buildings. The controls are DDC, but the actuation is pneumatic except for the Library/Science Building and the Kopp Center which are digital. There is also a dedicated Trane Trace System for the chillers.

There are five electric meters and eight natural gas meters at Century College. Any further sub-metering is not necessary since the meters are split between the major buildings and uses.

Findings Glossary: Findings Examples

a.1 (1)	Time of Day enabling is excessive
	<ul style="list-style-type: none"> • HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive
	<ul style="list-style-type: none"> • Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	Lighting is on more hours than necessary
	<ul style="list-style-type: none"> • Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	OTHER Equipment Scheduling and Enabling
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
b.1 (5)	Economizer Operation – Inadequate Free Cooling
	<ul style="list-style-type: none"> • Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	Over-Ventilation
	<ul style="list-style-type: none"> • Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	OTHER Economizer/Outside Air Loads
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
c.1 (8)	Simultaneous Heating and Cooling is present and excessive
	<ul style="list-style-type: none"> • For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement
	<ul style="list-style-type: none"> • OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints
	<ul style="list-style-type: none"> • CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	OTHER Controls
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
d.1 (12)	Daylighting controls or occupancy sensors need optimization
	<ul style="list-style-type: none"> • Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	Zone setpoint setup / setback are not implemented or are sub-optimal
	<ul style="list-style-type: none"> • The cooling setpoint is 74 °F 24 hours per day
d.3 (14)	Fan Speed Doesn't Vary Sufficiently
	<ul style="list-style-type: none"> • Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	Pump Speed Doesn't Vary Sufficiently
	<ul style="list-style-type: none"> • Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary
	<ul style="list-style-type: none"> • Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	Other Controls (Setpoint Changes)
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • HW supply temperature is a constant 180 °F. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • CHW supply temperature is a constant 42 °F. It could be reset, based on demand or ambient temperature.
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • The SAT is constant at 55 °F. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ()	Supply Duct Static Pressure Reset is not implemented or is suboptimal
	<ul style="list-style-type: none"> • The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal
	<ul style="list-style-type: none"> • CW temperature is constant leaving the tower at 85 °F. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	Other Controls (Reset Schedules)
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
f.1 (23)	Lighting system needs optimization - Spaces are overlit
	<ul style="list-style-type: none"> • Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	Pump Discharge Throttled
	<ul style="list-style-type: none"> • The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	Over-Pumping
	<ul style="list-style-type: none"> • Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	Equipment is oversized for load
	<ul style="list-style-type: none"> • The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	OTHER Equipment Efficiency/Load Reduction
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
g.1 (28)	VFD Retrofit Fans
	<ul style="list-style-type: none"> • Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	VFD Retrofit - Pumps
	<ul style="list-style-type: none"> • 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	VFD Retrofit - Motors (process)
	<ul style="list-style-type: none"> • Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	OTHER VFD
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
h.1 (32)	Retrofit - Motors
	<ul style="list-style-type: none"> • Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	Retrofit - Chillers
	<ul style="list-style-type: none"> • Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)
	<ul style="list-style-type: none"> • Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	Retrofit - Boilers
	<ul style="list-style-type: none"> • Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	Retrofit - Packaged Gas-fired heating
	<ul style="list-style-type: none"> • Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	Retrofit - Heat Pumps
	<ul style="list-style-type: none"> • Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	Retrofit - Equipment (custom)
	<ul style="list-style-type: none"> • Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	Retrofit - Pumping distribution method
	<ul style="list-style-type: none"> • Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	Retrofit - Energy / Heat Recovery
	<ul style="list-style-type: none"> • Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	Retrofit - System (custom)
	<ul style="list-style-type: none"> • Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	Retrofit - Efficient lighting
	<ul style="list-style-type: none"> • Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	Retrofit - Building Envelope
	<ul style="list-style-type: none"> • Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	Retrofit - Alternative Energy
	<ul style="list-style-type: none"> • Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	OTHER Retrofit
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
i.1 (46)	Differed Maintenance from Recommended/Standard
	<ul style="list-style-type: none"> • Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	Impurity/Contamination
	<ul style="list-style-type: none"> • Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ()	Leaky/Stuck Damper
	<ul style="list-style-type: none"> • The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ()	Leaky/Stuck Valve
	<ul style="list-style-type: none"> • The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	OTHER Maintenance
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval
j.1 (49)	OTHER
	<ul style="list-style-type: none"> • Please contact PBEEEP Project Engineer for approval



Findings Summary

Site: Century College

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	West Campus	AHU Economizer	\$3,170	\$2,779	1.14	\$4,895	-0.62	40
1	East Campus	AHU Schedules	\$3,420	\$8,410	0.41	\$6,515	-0.37	99
1	West Campus	AHU Equipment Schedule	\$3,170	\$15,857	0.20	\$8,616	-0.34	157
1	Library/Science Building	AHU Scheduling	\$1,960	\$3,198	0.61	\$1,708	0.08	33
2	East Campus	AHU Econcomizer	\$3,420	\$1,104	3.10	\$2,028	1.26	16
5	Library/Science Building	EF Scheduling	\$1,210	\$561	2.16	\$341	1.55	8
2	Kopp Technology Center	AHU-1 - Controls Setpoints	\$1,210	\$342	3.54	\$403	2.36	5
5	East Campus	Chilled Water System	\$2,880	\$579	4.97	\$992	3.26	8
4	Library/Science Building	AHU Controls Setpoints	\$1,710	\$273	6.28	\$412	4.76	4
3	Library/Science Building	AHU Controls Setpoints	\$1,460	\$212	6.88	\$321	5.37	3
1	Kopp Technology Center	AHU-1 - Economizer	\$1,210	\$170	7.12	\$257	5.61	2
2	Library/Science Building	AHU Coil Cleaning	\$2,960	\$494	5.99	\$0	5.99	7
3	West Campus	AHU Maintenance	\$1,460	\$139	10.51	\$0	10.51	2
3	Kopp Technology Center	AHU-1 - Coil cleaning	\$1,460	\$133	11.00	\$0	11.00	2
6	East Campus	Chilled Water System	\$5,760	\$409	14.08	\$757	12.23	6
		Total for Findings with Payback 3 years or less:	\$12,930	\$30,805	0.42	\$22,075	-0.30	337
		Total for all Findings:	\$36,460	\$34,661	1.05	\$27,245	0.27	394



Findings Summary

Building: East Campus
Site: Century College

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Schedules	\$3,420	\$8,410	0.41	\$6,515	-0.37	99
2	AHU Econcomizer	\$3,420	\$1,104	3.10	\$2,028	1.26	16
5	Chilled Water System	\$2,880	\$579	4.97	\$992	3.26	8
6	Chilled Water System	\$5,760	\$409	14.08	\$757	12.23	6
	Total for Findings with Payback 3 years or less:	\$3,420	\$8,410	0.41	\$6,515	-0.37	99
	Total for all Findings:	\$15,480	\$10,503	1.47	\$10,292	0.49	129

Findings Summary



Building: West Campus
Site: Century College

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU Economizer	\$3,170	\$2,779	1.14	\$4,895	-0.62	40
1	AHU Equipment Schedule	\$3,170	\$15,857	0.20	\$8,616	-0.34	157
3	AHU Maintenance	\$1,460	\$139	10.51	\$0	10.51	2
	Total for Findings with Payback 3 years or less:	\$6,340	\$18,636	0.34	\$13,511	-0.38	198
	Total for all Findings:	\$7,800	\$18,775	0.42	\$13,511	-0.30	200



Findings Summary

Building: Kopp Technology Center
Site: Century College

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU-1 - Controls Setpoints	\$1,210	\$342	3.54	\$403	2.36	5
1	AHU-1 - Economizer	\$1,210	\$170	7.12	\$257	5.61	2
3	AHU-1 - Coil cleaning	\$1,460	\$133	11.00	\$0	11.00	2
	Total for Findings with Payback 3 years or less:	\$0	\$0	0.00	\$0	0.00	0
	Total for all Findings:	\$3,880	\$645	6.02	\$660	4.99	9



Findings Summary

Building: Library/Science Building
Site: Century College

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Scheduling	\$1,960	\$3,198	0.61	\$1,708	0.08	33
5	EF Scheduling	\$1,210	\$561	2.16	\$341	1.55	8
4	AHU Controls Setpoints	\$1,710	\$273	6.28	\$412	4.76	4
3	AHU Controls Setpoints	\$1,460	\$212	6.88	\$321	5.37	3
2	AHU Coil Cleaning	\$2,960	\$494	5.99	\$0	5.99	7
	Total for Findings with Payback 3 years or less:	\$3,170	\$3,759	0.84	\$2,049	0.30	41
	Total for all Findings:	\$9,300	\$4,738	1.96	\$2,782	1.38	55

Findings Details



Building: East Campus

FWB Number:	10702	Eco Number:	1
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Schedules	Date Identified:	10/15/2010
Description of Finding:	Currently the air handling unit schedule on the BAS does not match actual occupancy schedules		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current scheduling of the equipment.		
Measure:	Provide schedule adjustments to match actual occupied hours for S-1 thru 8, S-13-1 & S-13-2. Total of Xcel ECO #1-1 thru #1-9		
Recommendation for Implementation:	Revise East Campus AHUs S-1, 2, 3, 4, 5, 6, 7, 8, 13-1 & 13-2 Runtime Schedules to match Campus Occupancy Schedule. Include optimum start timing to reach occupied setpoint for the following schedules: M-Th 7am - 10pm F 7am - 3:30pm Sa 7:30am - 4:30pm		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend SF and RF status (where it exists) and VFD speeds (where they exist) at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	66,446	Annual Natural Gas Savings (therms):	7,539
Estimated Annual kWh Savings (\$):	\$3,914	Estimated Annual Natural Gas Savings (\$):	\$4,497
Contractor Cost (\$):	\$1,500		
PBEEP Provider Cost for Implementation Assistance (\$):	\$1,920		
Total Estimated Implementation Cost (\$):	\$3,420		

Estimated Annual Total Savings (\$):	\$8,410	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.41	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	-0.37	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	99	Utility Co-Funding - Estimated Total (\$):	\$6,515

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	23.8%	Percent of Implementation Costs:	6.5%

Findings Details



Building: East Campus

FWB Number:	10702	Eco Number:	2
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Economizer	Date Identified:	10/15/2010
Description of Finding:	Currently the economizer enable/disable is set to 62 deg. F when chilled water is available		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current economizer control programmed for the equipment.		
Measure:	Adjust setting to 71 degF for S-1 thru 8 & RTU-1. Total of Xcel ECO #2-1 thru #2-9		
Recommendation for Implementation:	Revise East Campus AHUs S-1, 2, 3, 4, 5, 6, 7, 8 & RTU-1 economizer 'disable' setpoints to 71 degF.		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend OAT, MAT and RAT, and OA intake damper position at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	18,746	Contractor Cost (\$):	\$1,500
Estimated Annual kWh Savings (\$):	\$1,104	PBEEP Provider Cost for Implementation Assistance (\$):	\$1,920
		Total Estimated Implementation Cost (\$):	\$3,420

Estimated Annual Total Savings (\$):	\$1,104	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	3.10	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	1.26	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO ₂ e):	16	Utility Co-Funding - Estimated Total (\$):	\$2,028

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.1%	Percent of Implementation Costs:	6.5%

Findings Details



Building: East Campus

FWB Number:	10702	Eco Number:	5
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	Chilled Water System	Date Identified:	10/27/2010
Description of Finding:	The existing secondary chilled water pumps are piped in parallel but not controlled and modulated in parallel.		
Equipment or System(s):	Pump, secondary CHW (distr-only or evap and distr)	Finding Category:	Equipment Efficiency Improvements / Load Reduction
Finding Type:	Over-Pumping		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current control programming for the equipment.		
Measure:	Program the secondary chilled water pumps such that one pump is started and modulated. If a second pump is needed to maintain differential pressure setpoint, modulated both pump using the same control signal.		
Recommendation for Implementation:	Program the secondary chilled water pumps such that one pump is started and modulated. If a second pump is needed to maintain differential pressure setpoint, modulated both pump using the same control signal.		
Evidence of Implementation Method:	Trend the secondary chilled water pump speed at 15 minute intervals for a minimum of two calendar weeks during the summer months when the chilled water system is in used.		

Annual Electric Savings (kWh):	9,835	Contractor Cost (\$):	\$1,920
Estimated Annual kWh Savings (\$):	\$579	PBEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$2,880

Estimated Annual Total Savings (\$):	\$579	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	4.97	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	3.26	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	8	Utility Co-Funding - Estimated Total (\$):	\$992

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.6%	Percent of Implementation Costs:	5.5%

Findings Details



Building: East Campus

FWB Number:	10702	Eco Number:	6
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	Chilled Water System	Date Identified:	10/27/2010
Description of Finding:	The existing chilled water system has a fixed supply water setpoint of 42 degF.		
Equipment or System(s):	Chiller Plant	Finding Category:	Controls (Reset Schedules)
Finding Type:	CHW Supply Temperature Reset is not implemented or is sub-optimal		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current control programming for the equipment.		
Measure:	Program the chiller such that the chilled water supply setpoint it reset from 42-48 degF based on the required building load of all buildings AHUs requirement chilled water control valves.		
Recommendation for Implementation:	Program the chiller such that the chilled water supply setpoint it reset from 42-48 degF based on the required building load of all buildings AHUs requirement chilled water control valves. Do not allow the reset to take place when the outside air temperature is greater than 80 degF		
Evidence of Implementation Method:	Trend the chilled water supply temperature, AHU cooling valves, AHU supply air temperature and AHU return air humidity at 15 minute intervals for a minimum of two calendar weeks during the summer months when the chilled water system is in used.		

Annual Electric Savings (kWh):	6,948	Contractor Cost (\$):	\$4,800
Estimated Annual kWh Savings (\$):	\$409	PBEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$5,760

Estimated Annual Total Savings (\$):	\$409	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	14.08	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	12.23	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	6	Utility Co-Funding - Estimated Total (\$):	\$757

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	11.0%

Findings Details



Building: West Campus

FWB Number:	10701	Eco Number:	1
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Equipment Schedule	Date Identified:	11/17/2010
Description of Finding:	BAS equipment schedule does not match the actual occupancy schedule.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current scheduling of the equipment.		
Measure:	Recommend matching actual occupancy schedule. Total of Xcel ECO #1-1 thru #1-14		
Recommendation for Implementation:	Revise West Campus AHU-1, 2, 4, 6, 7, 9, 10, 17, 18, 19, 20, 21, J1 & K1 Runtime Schedules to match Campus Occupancy Schedule. Include optimum start timing to reach occupied setpoint for the following schedules: M-Th 7am - 10pm F 7am - 3:30pm Sa 7:30am - 4:30pm		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend SF and RF status (where it exists) and VFD speeds (where they exist) at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	102,222	Annual Natural Gas Savings (therms):	12,618
Estimated Annual kWh Savings (\$):	\$6,021	Estimated Annual Natural Gas Savings (\$):	\$9,836
Contractor Cost (\$):	\$1,250		
PBEEP Provider Cost for Implementation Assistance (\$):	\$1,920		
Total Estimated Implementation Cost (\$):	\$3,170		

Estimated Annual Total Savings (\$):	\$15,857	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.20	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	-0.34	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	157	Utility Co-Funding - Estimated Total (\$):	\$8,616

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	44.9%	Percent of Implementation Costs:	6.1%

Findings Details



Building: West Campus

FWB Number:	10701	Eco Number:	2
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Economizer	Date Identified:	11/17/2010
Description of Finding:	Currently the economizer disable setpoints are at 60degF.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current economizer control programmed for the equipment.		
Measure:	Program controls to allow economizer enable/disable. Total of Xcel ECO #2-1 thru #2-17		
Recommendation for Implementation:	Revise West Campus AHU-1, 2, 3, 4, 5, 6, 7, 9, 10, 15, 16, 17, 18, 20, 21, J1 & K1 economizer 'disable' setpoints to 71 degF.		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend OAT, MAT and RAT, and OA intake damper position at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	47,175	Contractor Cost (\$):	\$1,250
Estimated Annual kWh Savings (\$):	\$2,779	PBEEP Provider Cost for Implementation Assistance (\$):	\$1,920
		Total Estimated Implementation Cost (\$):	\$3,170

Estimated Annual Total Savings (\$):	\$2,779	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	1.14	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	-0.62	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	40	Utility Co-Funding - Estimated Total (\$):	\$4,895

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	7.9%	Percent of Implementation Costs:	6.1%

Findings Details



Building: West Campus

FWB Number:	10701	Eco Number:	3
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Maintenance	Date Identified:	12/1/2010
Description of Finding:	Currently there is an outside air pre-heat coil with face and bypass that is not controlled by the BAS. The coil is extremely dirty.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Deferred Maintenance from Recommended/Standard		

Implementer:	Maintenance staff	Benefits:	Energy savings
Baseline Documentation Method:	Observation, see photo. Pressure drop taken and compared to pressure drop of clean coil.		
Measure:	Recommend cleaning coil to reduce static pressure across coil. Xcel ECO #1-15		
Recommendation for Implementation:	Properly clean both sides of heating and cooling coils with detergent designed for coil cleaning.		
Evidence of Implementation Method:	Visually inspect AHU-2 heating and cooling coils after cleaning has been completed.		

Annual Electric Savings (kWh):	2,360	Contractor Cost (\$):	\$500
Estimated Annual kWh Savings (\$):	\$139	PBEEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$1,460

Estimated Annual Total Savings (\$):	\$139	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	10.51	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	10.51	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	2	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.4%	Percent of Implementation Costs:	2.8%

Findings Details



Building: Kopp Technology Center

FWB Number:	10703	Eco Number:	1
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU-1 - Economizer	Date Identified:	10/1/2010
Description of Finding:	Currently the economizer enable is 60 deg. F dry-bulb.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls Contractor to program this measure into BAS	Benefits:	Optimize the economizer temperature settings provides savings from free cooling
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current economizer control programmed for the equipment.		
Measure:	Recommend setting economizer enable to 71 deg. F.		
Recommendation for Implementation:	Revise Kopp Center AHU-1 economizer 'disable' setpoint to 71 degF (adjustable).		
Evidence of Implementation Method:	During either swing season when school is in session, trend OAT, AHU-1 MAT and RAT, and OA intake damper position at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	2,885	Peak Demand Savings (kWh):	4
Estimated Annual kWh Savings (\$):	\$170	Estimated Annual Demand Savings (\$):	\$0
Contractor Cost (\$):	\$250		
PBEEP Provider Cost for Implementation Assistance (\$):	\$960		
Total Estimated Implementation Cost (\$):	\$1,210		

Estimated Annual Total Savings (\$):	\$170	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	7.12	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	5.61	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total (\$):	\$257

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.5%	Percent of Implementation Costs:	2.3%

Findings Details



Building: Kopp Technology Center

FWB Number:	10703	Eco Number:	2
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU-1 - Controls Setpoints	Date Identified:	10/5/2010
Description of Finding:	Currently the duct static pressure setpoint is a constant at 1.30" wc even though there seems to be a High/Low duct pressure setpoint input.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		

Implementer:	Controls Contractor to program this measure into BAS	Benefits:	Lower fan static pressure results in fan energy savings.
Baseline Documentation Method:	Review trending, completed functional testing and took screen captures to determine the current control programmed for the equipment.		
Measure:	Recommend duct static pressure setpoint reset.		
Recommendation for Implementation:	Revise Kopp Center AHU-1 High Static Pressure setpoint to 1.2"wg and Low Static Pressure setpoint to 0.8"wg		
Evidence of Implementation Method:	During either swing season when school is in session, trend Supply Duct Static Pressure at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	5,809	Peak Demand Savings (kWh):	3
Estimated Annual kWh Savings (\$):	\$342	Estimated Annual Demand Savings (\$):	\$0
Contractor Cost (\$):	\$250		
PBEEEP Provider Cost for Implementation Assistance (\$):	\$960		
Total Estimated Implementation Cost (\$):	\$1,210		

Estimated Annual Total Savings (\$):	\$342	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	3.54	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	2.36	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	5	Utility Co-Funding - Estimated Total (\$):	\$403

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.0%	Percent of Implementation Costs:	2.3%

Findings Details



Building: Kopp Technology Center

FWB Number:	10703	Eco Number:	3
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU-1 - Coil cleaning	Date Identified:	10/5/2010
Description of Finding:	Currently the air handling unit coils need cleaning.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Impurity/Contamination		

Implementer:	In House staff can implement this measure	Benefits:	Removing dirt and built-up from coils reduces static pressure across the coil and provide fan energy savings.
Baseline Documentation Method:	Site observations and differential pressure readings across coil.		
Measure:	Recommend changing filters and cleaning coils.		
Recommendation for Implementation:	Clean Kopp Center AHU-1 heating and cooling coils.		
Evidence of Implementation Method:	Visually inspect heating and cooling coils after cleaning has been completed.		

Annual Electric Savings (kWh):	2,253	Peak Demand Savings (kWh):	5
Estimated Annual kWh Savings (\$):	\$133	Estimated Annual Demand Savings (\$):	\$0
Contractor Cost (\$):	\$500		
PBEEEP Provider Cost for Implementation Assistance (\$):	\$960		
Total Estimated Implementation Cost (\$):	\$1,460		

Estimated Annual Total Savings (\$):	\$133	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	11.00	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	11.00	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	2	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.4%	Percent of Implementation Costs:	2.8%

Findings Details



Building: Library/Science Building

FWB Number:	10704	Eco Number:	1
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Scheduling	Date Identified:	9/20/2010
Description of Finding:	Currently BAS schedule does not match actual building occupancy.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Screen captures		
Measure:	Recommend matching occupancy schedule to reduce equipment hours.		
Recommendation for Implementation:	Revise LRC AHU-1, 2, 3, 4 Runtime Schedule to match LRC Occupancy Schedule. Include optimum start timing to reach occupied setpoint for the following schedules: M-F 7:30am - 9pm Sa 7:30am - 4:30pm Su 9am - 3pm		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend SF and RF status and VFD speed at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	19,730	Annual Natural Gas Savings (therms):	2,865
Estimated Annual kWh Savings (\$):	\$1,162	Estimated Annual Natural Gas Savings (\$):	\$2,036
Contractor Cost (\$):	\$1,000		
PBEEP Provider Cost for Implementation Assistance (\$):	\$960		
Total Estimated Implementation Cost (\$):	\$1,960		

Estimated Annual Total Savings (\$):	\$3,198	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	0.61	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	0.08	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	33	Utility Co-Funding - Estimated Total (\$):	\$1,708

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	9.1%	Percent of Implementation Costs:	3.7%

Findings Details



Building: Library/Science Building

FWB Number:	10704	Eco Number:	2
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Coil Cleaning	Date Identified:	9/20/2010
Description of Finding:	Currently the air handling unit coils need cleaning.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Deferred Maintenance from Recommended/Standard		

Implementer:	In House staff can implement this measure	Benefits:	Removing dirt and built-up from coils reduces static pressure across the coil and provide fan energy savings.
Baseline Documentation Method:	Observation, screen capture.		
Measure:	Recommend changing filters and cleaning coils.		
Recommendation for Implementation:	Clean LRC AHU-1, 2, 3, 4 heating and cooling coils.		
Evidence of Implementation Method:	For each AHU, visually inspect heating and cooling coils after cleaning has been completed.		

Annual Electric Savings (kWh):	8,395	Contractor Cost (\$):	\$2,000
Estimated Annual kWh Savings (\$):	\$494	PBEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$2,960

Estimated Annual Total Savings (\$):	\$494	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	5.99	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	5.99	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	7	Utility Co-Funding - Estimated Total (\$):	\$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.4%	Percent of Implementation Costs:	5.7%

Findings Details



Building: Library/Science Building

FWB Number:	10704	Eco Number:	3
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Controls Setpoints	Date Identified:	9/20/2010
Description of Finding:	Currently the duct static pressure setpoint is a constant at 1.30" wc even though there seems to be a High/Low duct pressure setpoint input.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		

Implementer:	Controls Contractor to program this measure into BAS	Benefits:	Lower fan static pressure results in fan energy savings.
Baseline Documentation Method:	Observation, screen capture.		
Measure:	Recommend duct static pressure setpoint reset.		
Recommendation for Implementation:	Revise LRC AHU-1 High Static Pressure setpoint to 1.2"wg and Low Static Pressure setpoint to 0.8"wg		
Evidence of Implementation Method:	During either swing season when school is in session, trend Supply Duct Static Pressure at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	3,603	Contractor Cost (\$):	\$500
Estimated Annual kWh Savings (\$):	\$212	PBEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$1,460

Estimated Annual Total Savings (\$):	\$212	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	6.88	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	5.37	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	3	Utility Co-Funding - Estimated Total (\$):	\$321

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	2.8%

Findings Details



Building: Library/Science Building

FWB Number:	10704	Eco Number:	4
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	AHU Controls Setpoints	Date Identified:	9/20/2010
Description of Finding:	Currently the economizer enable is 60 deg. F dry-bulb.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls Contractor to program this measure into BAS	Benefits:	Optimize the economizer temperature settings provides savings from free cooling
Baseline Documentation Method:	Observation, screen capture.		
Measure:	Recommend setting economizer enable to 71 deg. F.		
Recommendation for Implementation:	Revise LRC AHU-1, 2, 3 economizer 'disable' setpoint to 71 degF (adjustable).		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend OAT, MAT and RAT, and OA intake damper position at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	4,627	Contractor Cost (\$):	\$750
Estimated Annual kWh Savings (\$):	\$273	PBEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$1,710

Estimated Annual Total Savings (\$):	\$273	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	6.28	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	4.76	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	4	Utility Co-Funding - Estimated Total (\$):	\$412

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.8%	Percent of Implementation Costs:	3.3%

Findings Details



Building: Library/Science Building

FWB Number:	10704	Eco Number:	5
Site:	Century College	Date/Time Created:	1/18/2012

Investigation Finding:	EF Scheduling	Date Identified:	9/20/2010
Description of Finding:	Currently EF BAS schedule does not match actual building occupancy.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy savings
Baseline Documentation Method:	Screen captures		
Measure:	Recommend matching occupancy schedule to reduce equipment hours.		
Recommendation for Implementation:	Revise LRC EF-311 Runtime Schedule to match LRC Occupancy Schedule: M-F 7:30am - 9pm Sa 7:30am - 4:30pm Su 9am - 3pm		
Evidence of Implementation Method:	For each AHU, during either swing season when school is in session, trend EF status at 15 minute intervals for a minimum of two calendar weeks.		

Annual Electric Savings (kWh):	9,523	Contractor Cost (\$):	\$250
Estimated Annual kWh Savings (\$):	\$561	PBEEEP Provider Cost for Implementation Assistance (\$):	\$960
		Total Estimated Implementation Cost (\$):	\$1,210

Estimated Annual Total Savings (\$):	\$561	Utility Co-Funding for kWh (\$):	\$0
Initial Simple Payback (years):	2.16	Utility Co-Funding for kW (\$):	\$0
Simple Payback w/ Utility Co-Funding (years):	1.55	Utility Co-Funding for therms (\$):	\$0
GHG Avoided in U.S. Tons (CO2e):	8	Utility Co-Funding - Estimated Total (\$):	\$341

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.6%	Percent of Implementation Costs:	2.3%

In our review process, there were a number of potential energy saving measures initially identified by CEE and investigated by Hallberg Engineering that do not appear in the final report. These were measures with energy savings potential that was not possible to accurately quantify and thus they did not meet the PBEEEP Guidelines for having a certain payback. Best practices would call for addressing these potential opportunities.

The primary reason these things are not in the report is the lack of data on their operation, in some cases because they are pneumatically operated (such as VAV boxes and exhaust fans) and not on the Building Automation System (BAS), and in others because insufficient data was collected during the investigation to characterize the operation.

West Campus

The whole building is composed of multiple additions each with its own independent mechanical systems. In the future, energy could be saved by consolidating some smaller systems; this would reduce both fan energy use and maintenance.

A discharge air temperature (DAT) reset should be implemented in all the air handlers that do not have heating coils (cooling only units). These units should be optimized to increase the discharge air temperature (DAT) in the heating season. The current low DAT settings bring in cold outside air in winter which must then be re-heated at the terminal VAV boxes.

All exhaust fans should be connected to and controlled by the BAS. They currently run all the time, even when they are not needed. They should be scheduled to match the building hours.

East Campus

Dual Duct air handlers S-1 to S-9: There is significant energy savings potential for these units if the current pneumatic VAV box controllers are removed and replaced with direct digital controls (DDC) and controlled based on three variables: space temperatures; the status of the VAV boxes; and flow of the VAV boxes to optimize the AHU operation. This would lead to electrical and natural gas savings. Because these systems are not on the BAS they were not monitored for long periods of time thus accurate energy calculations were not produced in the investigation.

The make-up air units in the automotive shops should be investigated to see if they could benefit from either a energy recovery or maybe retrofitted with AHUs/RTUs.

All exhaust fans should be connected to and controlled by the BAS. They currently run all the time, even when they are not needed. They should be scheduled to match the building hours.

LRC

The 1/3 & 2/3 valve arrangement should be reprogrammed to function as designed with the 1/3 valve modulating for hot water and the 2/3 valve for chilled water. Both valves should not modulate together.

The labs in the building should be evaluated for OA flow and exhaust to ensure correct pressure relationships and reduce the amount of OA conditioning. Many laboratory spaces are over ventilated because they are designed based on safety considerations at their periods of maximum occupancy; however standard practices call for all hazardous materials to be properly stored when laboratories are not in use and ventilation levels can be substantially reduced. A full time laboratory building uses four to five times as much energy as classroom space; if the laboratory is really only used 4 hours a day, 4 days a week for 28 weeks of the year (typical academic use) that means that the systems may be using excessive energy about 95% of the time.

All exhaust fans should be connected to and controlled by the BAS. They currently run all the time, even when they are not needed. They should be scheduled to match the building hours.

Kopp Center

Evaluate server room cooling and ventilation. Recent studies by Intel have shown that current electronics are much more robust than those of a decade ago; server room temperatures as high as 95 degrees F do not appear to have any impact on system performance or lifetime. Higher temperature settings and reduced conditioning of outside air can save a lot of energy in a 24/7 room.

All exhaust fans should be connected to and controlled by the BAS. They currently run all the time, even when they are not needed. They should be scheduled to match the building hours.



January 06, 2012

Dear Mr. Fields:

These are the findings notes from Hallberg Engineering's walk-throughs for the East Campus, West Campus, LRC and Kopp Center for your use. In addition to the four projects, the Generic Outline of Findings is the basic outline of the findings that are reviewed for all HVAC equipment within the scope of the project.

Please remember that these are notes to be reviewed for possible ECOs with no explanations; thus, this information is the raw data review for possible ECOs to be outlined in the final report. The document is broken down by equipment name and all findings.

If you have any additional questions, please let me know.

Sincerely,

John Parks, CxA, LEED AP
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1750 Commerce Court
White Bear Lake, MN 55110

West Campus Outline of Findings

AHU-5 Outline of Findings – Rooms 1030, 2030 and 3030

Finding Type Number: (11/17/10)

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-F 7am-6pm; 55 total hours. Recommend adhering to the class scheduled for the campus.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
 - b. No access panel to view actual damper position. Used mixed air temperature sensor to determine if outside air damper is mostly closed and return damper is mostly open at 0% damper signal.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. No access panel to view actual damper position. Used mixed air temperature sensor to determine if outside air damper is mostly open and return damper is mostly closed at 100% damper signal.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The reheat coil valve is open most of the time in colder weather. This is because the supply air temperature sensor is located upstream from the reheat coil thus not sensing the actual supply air temperature. See trending data.
11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-1 Outline of Findings – Band and Choir Rooms

Finding Type Number: (11/17/10)

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=6am-10pm, Fri=6am-8pm and Sat=7am-4pm; 85 total hours. Recommend adhering to the class scheduled for the campus.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
 - b. No access panel to view actual damper position. Used mixed air temperature sensor to determine if outside air damper is mostly closed and return damper is mostly open at 0% damper signal.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. No access panel to view actual damper position. Using mixed air temperature sensor and supply air sensor the outside air damper do not closed completely; there is a 7 degF delta-T from return air to mixed/supply air.
7. Economizer Outside Air Loads: Other Economizer/OA Loads:

- a. Recommend an installation of CO2 demand control ventilation for reduction of fan speeds, heating and cooling requirements and outside air ventilation when space is not in use or during low occupancy.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-2 Outline of Findings – Rooms 1040, 1060, 1070, 2040, 2045

Finding Type Number (12/01/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-10pm, Fri=5am-8pm, Sat=7am-4pm and Sun=9pm-11:30pm; 94.5 total hours. Recommend adhering to the class scheduled for the campus.
 - b. The Supply Fan does not shut down when scheduled OFF.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. This unit has two (2) reheat coils with each having a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
- 48. Other Maintenance
 - a. There is an outside air pre-heat coil with face/bypass that is not controlled by the BAS. The coil is extremely dirty (see photo).

AHU-3 Outline of Findings – Theatre

Finding Type Number (12/01/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-F=6am-8pm; 70 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Recommend an installation of CO2 demand control ventilation for reduction of fan speeds, heating and cooling requirements and outside air ventilation when space is not in use or during low occupancy.
- 11. Control Problems: Other

- a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-4 Outline of Findings – 2060, 2080, 3040, 3080 and Faculty

Finding Type Number (12/01/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Thu=4am-11pm, Fri=4am-8pm, Sat=7am-4pm and Sun=9:30pm=12:00am; 103.5 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. No access panel to view actual damper position.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. One reheat valve that is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
- 48. Other Maintenance
 - a. The return fan relieves air into mechanical room. There is chemical storage within the mechanical room. Recommend removing any chemicals within the space and cleaning the space.

AHU-6 Outline of Findings – West Building Area D/E

Finding Type Number (12/01/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Thu=5am-10pm, Fri=5am-7pm, Sat=6am-4pm and Sun=9:00pm=12:30am; 95.5 total hours. Recommend adhering to the class scheduled for the campus.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The scheduled minimum OA is 9600 cfm. The current setpoint is 6000cfm. Recommend verification/calibration of OA AFMS and reset minimum OA to scheduled value.
 - b. OA dampers modulating open/closed in a wide range of 30% open to 45% open within 1-2 minutes of modulation causing the OA cfm with overshoot/undershoot its required value. Recommend that the OA damper control to fine tuned so that the correct OA minimum is maintained.
- 7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - b. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 9. Control Problems: Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement
 - a. The cooling coil supply air temperature sensor on the lower coil is reading 126 degF. Recommend verification/replacement.

10. Control Problems: Controls “hunt” and/or need Loop Tuning or separation of heating/cooling setpoints
- OA dampers modulating open/closed in a wide range of 30% open to 45% open within 1-2 minutes of modulation causing the OA cfm with overshoot/undershoot its required value. Recommend that the OA damper control to fine tuned so that the correct OA minimum is maintained.
11. Control Problems: Other
- The freeze stat tripped but the HW coil valve did not open to allow hot water into the coil.
 - The heating coil loop recirculating pump did not shut off when the outside air temperature increase above the enable setpoint.
 - The supply air duct static pressure sensor is reading 0.02”wc. Recommend verifying/calibrating the static pressure sensor.
 - The return fan (R-6/7) speed modulates between 28 Hz and 37 Hz with a 90 period. Recommend verification/calibration of AFMS with BAS and fine tune the PID loop for the return fan speed control.
 - The value of the supply fan AFMS from the manufacturer does not coincide with the BAS. For control purposes, verify/calibrate the BAS to AFMS reading.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- There is no supply air temperature reset. Recommend resetting supply air temperature based on the space temperatures.
22. Controls Setpoint Changes: Other
- AHU-6 and AHU-7 are ducted in parallel. The VAV boxes supplied by the two AHUs are approximately 20,000cfm at minimum flow. Recommend using one of the AHUs and only add the other in parallel when the required VAV box flow is more that one AHU can supply.
48. Other Maintenance
- VAV 3-31 (Room 3120) – The VAV box flow rate is reading 0.00. The reheat valve is indicating 0% open but the supply air temperature sensor at the VAV box is reading 77 degF. The space temperature is 78 degF.
 - VAV2-12 (Serves Open to Below Windows) – The reheat valve indicates 100% open but the VAV box supply air temperature is 57 degF.
 - VAV3-09 (3280) – The VAV box supply air temperature sensor is reading “NaN”.
 - VAV3-10 – The space temperature sensor is reading “NaN”.

AHU-7 Outline of Findings – West Building Area D/E

Finding Type Number (12/01/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
- Took a schedule screen capture. The schedule for the BAS is M-Thu=5am-10pm, Fri=5am-7pm, Sat=6am-4pm and Sun=9:00pm=12:30am; 95.5 total hours. Recommend adhering to the class scheduled for the campus.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- The scheduled minimum OA is 9600 cfm. The current setpoint is 6000cfm. Recommend verification/calibration of OA AFMS and reset minimum OA to scheduled value.
 - The outside air dampers did not modulate open to meet the minimum outside air flow requirement listed.
7. Economizer Outside Air Loads: Other Economizer/OA Loads:
- No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
11. Control Problems: Other
- The freeze stat tripped but the HW coil valve did not open to allow hot water into the coil.
 - The heating coil loop recirculating pump did not shut off when the outside air temperature increase above the enable setpoint.

- c. The supply air duct static pressure sensor is reading 0.12"wc. Recommend verifying/calibrating the static pressure sensor.
 - d. The return fan (R-6/7) speed modulates between 28 Hz and 37 Hz with a 90 period. Recommend verification/calibration of AFMS with BAS and fine tune the PID loop for the return fan speed control.
 - e. The value of the supply fan AFMS from the manufacturer does not coincide with the BAS. For control purposes, verify/calibrate the BAS to AFMS reading.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- a. There is no supply air temperature reset. Recommend resetting supply air temperature based on the space temperatures.
22. Controls Setpoint Changes: Other
- a. AHU-6 and AHU-7 are ducted in parallel. The VAV boxes supplied by the two AHUs are approximately 20,000cfm at minimum flow. Recommend using one of the AHUs and only add the other in parallel when the required VAV box flow is more that one AHU can supply.

AHU-16 Outline of Findings – 2nd Flr C-Area

Finding Type Number (12/02/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-8pm, Fri=5am-6pm, Sat=7am-4pm; 82 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-17 Outline of Findings – 3rd Flr C-Area

Finding Type Number (12/02/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=4am-10pm, Fri=4am-8pm, Sat=7am-4pm, Sun=8pm-11:30pm; 100.5 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-15 Outline of Findings – Cafeteria

Finding Type Number (12/02/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-10pm, Fri=5am-8pm; 83 total hours. Recommend adhering to the class scheduled for the campus.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Recommend an installation of CO2 demand control ventilation for reduction of fan speeds, heating and cooling requirements and outside air ventilation when space is not in use or during low occupancy.
11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
48. Other Maintenance
 - a. The return air damper does not open when commanded, thus when at minimum OA the OA damper is closed and the return air damper is closed.

AHU-9 Outline of Findings – Rooms 1094, 2120, 2140, 2160, 2180, 2190, 2195, 1st Flr Faculty

Finding Type Number (12/06/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-10pm, Fri=5am-8pm, Sat=6am-4pm; 93 total hours. Recommend adhering to the class scheduled for the campus.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. The outside air dampers are always at 45% damper position (whether the unit is running or not). The return air dampers are always at 100%.
11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-10 Outline of Findings – Rooms 1140, 1170, 1190

Finding Type Number (12/02/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.

- a. Took a schedule screen capture. The schedule for the BAS is M-Th=6am-10pm, Fri=6am-8pm, Sat=7am-4pm; 87 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-20 Outline of Findings – D-Building

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=4am-11:30pm, Fri=4am-8pm, Sat=7am-4pm, Sun=8pm-11:30pm; 103.5 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. No access to view the actual position of the OA/RA dampers. Using the mixed air and supply air temperature, the damper leakage is minimal and seems to be in the closed position. See screen capture in pictures file.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-18 Outline of Findings – Fitness Center, Phys Ed Offices, Men's and Women's Locker Rooms

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=6am-10pm, Fri=6am-8pm, Sat=7am-4pm; 87 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.

- a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Recommend an installation of CO2 demand control ventilation for reduction of fan speeds, heating and cooling requirements and outside air ventilation when space is not in use or during low occupancy.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. The hot deck temperature is not being reset. Recommend reset of hot deck temperature based on space temperature conditions in area being served.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-19 Outline of Findings – Gym

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-10pm, Fri=5am-8pm, Sun=9pm-11:30pm; 85.5 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Recommend an installation of CO2 demand control ventilation for reduction of fan speeds, heating and cooling requirements and outside air ventilation when space is not in use or during low occupancy.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
 - b. The cold deck temperature sensor is actually sensing the duct temperature of the east side supply duct temperature.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. The hot deck temperature is not being reset. Recommend reset of hot deck temperature based on space temperature conditions in area being served.

AHU-21 Outline of Findings – D-Building

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=4am-10pm, Fri=4am-7pm, Sat=7am-4pm; 100 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.

- a. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. The hot deck temperature is not being reset. Recommend reset of hot deck temperature based on space temperature conditions in area being served.
 - b. The cold deck temperature is not being reset. Recommend reset of cold deck temperature based on space temperature conditions in area being served.
- 27. Other Equipment Efficiency/Load Reduction
 - a. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
 - b. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

AHU-J1 Outline of Findings – Rooms 1001, 1006, 2001 - 2010

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=4am-10pm, Fri=4am-8pm, Sat=4am-4pm, Sun=9pm-12:30am; 103.5 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. OA damper does not close completely.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
 - b. The space temperature sensor for Room 1001 is reading 0.0 degF.
 - c. The heating valve indicates “Closed” when actually 100% open.

AHU-K1 Outline of Findings – Rooms 2090, 3090

Finding Type Number (12/06/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-Th=5am-10pm, Fri=5am-8pm, Sat=7am-4pm; 92 total hours. Recommend adhering to the class scheduled for the campus.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. No economizer enable/disable listed on graphics pages for West Campus. Recommend setting at 71 degF.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The minimum damper position is set to 0% because of the amount of damper leakage.
 - b. The damper does not closed completely and is open around 30% all of the time. Could not take a good picture because there is only a 2” diameter peep hole and no other access to view the damper position.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 27. Other Equipment Efficiency/Load Reduction

- c. The heating valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.
- d. The cooling valve is a 3-way valve. Recommend changing to 2-way to reduce the pump requirement at the physical plant.

West Campus Boiler Plant

Finding Type Number:

2. Equipment Scheduling and Enabling: Equipment is enabled regardless of need, or such enabling is excessive:

- a. Summer boiler is currently enabled/disabled by the outside air temperature. Recommend enabling/disabling based on outside air temperature and if the main physical plant is providing hot water to the system.

East Building Outline of Findings

Chilled Water System Findings

Finding Type Number:

2. Equipment Scheduling and Enabling: Equipment is enabled regardless of need, or such enabling is excessive:
 - a. Verify chiller schedule with campus schedule. The chillers are enabled by schedule and OAT with no feedback from actual building load
 15. Controls Setpoint Changes: Pump Speed Doesn't Vary Sufficiently
 - a. The East and West buildings have three pumps serving each side; Lead/Lag/Standby. When the first pump is started it ramps to 100% speed and then the second pump starts to control to the building differential setpoint.
 19. Controls Setpoint Changes: CHW Supply Temperature Reset is not implemented or is sub-optimal
 - a. No reset is enabled for either building secondary loop. Only the LRC has a heat exchanger to allow varying chilled water temperatures within the building loop.
 21. Controls Setpoint Changes: Condenser Water Temperature Reset is not implemented or is sub-optimal
 - a. The condenser water temperature setpoint is 79 degF with no variance. Investigate varying the condenser water for these models of chillers.
 - b. The cooling tower fans ramp in parallel.
 24. Pump Discharge Throttled
 - a. The three pumps for the East Campus have been throttled at the triple duty valve.
 - b. The three pumps for the West Campus have been throttled at the triple duty valve.
 - c. The three pumps for the chilled water primary loop have been throttled.
 25. Over-Pumping
 - a. 3-way cooling coil control valves installed at various AHU.
 47. Impurity/Contamination
 - a. The cooling tower has some scaling and may need to be cleaned.
- Maintenance/Controls**
48. Other Maintenance
 - a.
 49. Other
 - a. The chiller load power factor at indicated on the chiller control panel is 0.82

AHU-1 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=3am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 101 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)

- a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers are original equipment and do not close completely with no edge seals remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
- 8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. Verify the actuation on the hot deck/cold deck dampers.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 17. Controls Setpoint Changes: Other
 - a. Chilled water flow with cooling valve at 0% open; DAT setpoint at 60 degF but actual DAT at 54 degF.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
- 25. Over-Pumping
 - b. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
- 47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
- 48. Other Maintenance
 - a.

AHU-2 Outline of Findings

Finding Type Number:

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M-F=5am-10pm Sat=6am-4pm for a total of 95 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - a. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers are original equipment and do not close completely with no edge seals remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.

20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
25. Over-Pumping
- a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
47. Impurity/Contamination
- a. Verify air filter replacement schedule.
48. Other Maintenance
- a.

AHU-3 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
- a. Took a schedule screen capture. The schedule for the BAS is M=3am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 101 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
- a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- a. The OA/RA/Relief Air dampers do not close completely. remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
11. Control Problems: Other
- a. Dampers and valves are pneumatic controlled.
17. Controls Setpoint Changes: Other
- a. Chilled water flow with cooling valve at 0% open; DAT setpoint at 60 degF but actual DAT at 54 degF.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
25. Over-Pumping
- a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
47. Impurity/Contamination
- a. Verify air filter replacement schedule.
48. Other Maintenance
- a.

AHU-4 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=5am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 99 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers do not close completely. remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
17. Controls Setpoint Changes: Other
 - a. Chilled water flow with cooling valve at 0% open; DAT setpoint at 60 degF but actual DAT at 54 degF.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
25. Over-Pumping
 - a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
48. Other Maintenance
 - a.

AHU-5 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=3am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 101 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers do not close completely.

- b. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
- 25. Over-Pumping
 - a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
- 47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
- 48. Other Maintenance
 - a.

AHU-6 Outline of Findings

Finding Type Number:

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=5am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 99 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
- 5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers do not close completely. remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
- 25. Over-Pumping
 - a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
- 47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
- 48. Other Maintenance
 - a.

AHU-7 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=3am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 101 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers do not close completely. remaining.
 - b. The minimum damper position is set to 0% because of the amount of damper leakage.
11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
25. Over-Pumping
 - a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
48. Other Maintenance
 - a. No Chilled water flow with cooling valve at 100% open; DAT setpoint at 60 degF but actual DAT at 70 degF.

AHU-8 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took a schedule screen capture. The schedule for the BAS is M=5am-10pm T-F=5am-10pm Sat=6am-4pm Sun=8pm-12pm for a total of 99 hour/week. The campus hours are advertised at M-Th=7am-10pm; F=7am-5pm; Sat=7am-4pm and Sun=Closed for a total of 79 hours/week with campus being closed during breaks and special holiday as noted on the website.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Economizer enable/disable when chilled water is available; currently set at 62 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The OA/RA/Relief Air dampers do not close completely. remaining.

- b. The minimum damper position is set to 0% because of the amount of damper leakage.
- 11. Control Problems: Other
 - a. Dampers and valves are pneumatic controlled.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. No supply air temperature reset based on space temperature demands. The hot deck and cold deck are reset by return air temperature.
- 25. Over-Pumping
 - a. The chilled water valve is pneumatic; it is also 3-way valve. Since the secondary chilled water pumps are VFD controlled, the system is being over pumped by using the 3-way valve configuration.
- 47. Impurity/Contamination
 - a. Verify air filter replacement schedule.
- 48. Other Maintenance
 - a. No Chilled water flow with cooling valve at 100% open; DAT setpoint at 60 degF but actual DAT at 70 degF.

Penthouse Steam-to-Hot Water Heat Exchanger (PHX-1 thru PHX-4) Outline of Findings

Finding Type Number:

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The heat exchangers and associated pump are enabled by outside air temperature; currently set to 40 degF with no space load feedback.
 - b. The heat exchangers and associated pump are enabled by outside air temperature; currently set to 40 degF with feedback from the physical plant on whether or no steam is available.

S9-1-E (Outboard Test Area)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The hot water valve is modulating open even though the supply fan is not running and the outside air temperature is above freezing conditions.
 - c. The heating valve is open when the BAS indicates closed. The valve is 0% open (100% Closed at indicated on the graphics page), the mixed air temperature is 63 degF and the supply air temperature is 73 degF. See screen capture below.



40. Retrofit - Energy/Heat Recovery

- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S9-2-E (Back of Shop Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The hot water valve is modulating open even though the supply fan is not running and the outside air temperature is above freezing conditions.
 - c. The amp drawing on the fan does not change from 0 amps when the fan is running.
 - d. When the fan is not running, the heating valve is open when the BAS indicates closed. See screen capture below.



40. Retrofit - Energy/Heat Recovery

- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S9-3-E (Front of Shop Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The hot water valve is modulating open even though the supply fan is not running and the outside air temperature is above freezing conditions.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S9-4-E (Laundry Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. All of the S-9 fans are under the same schedule even though S9-4-E is in a different area of the building. Will need to verify class schedule for actual occupancy of area.

6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
- a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The hot water valve is modulating open even though the supply fan is not running and the outside air temperature is above freezing conditions.
 - c. When the heating valve indicates 100% closed, the mixed and supply temperatures are above 100 degF. This would indicate that the heat valve is not closing.
40. Retrofit - Energy/Heat Recovery
- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S9-5-E (Duplicating Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
- a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. All of the S-9 fans are under the same schedule even though S9-5-E is in a different area of the building. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
- a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
40. Retrofit - Energy/Heat Recovery
- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S10-1-E (Auto Body Left Door Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
- a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
- a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open but the supply air temperature is not increasing above the mixed air temperature.
40. Retrofit - Energy/Heat Recovery
- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S10-2-E (Building Maintenance Classroom)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 5:30am – 5pm for a total of 57.5 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The hot water valve is opening even though the mixed air temperature is satisfying the supply air temperature setpoint. Took screen capture.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S10-3-E (208/Bldg Offices)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 9pm for a total of 60 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The hot water valve is opening even though the mixed air temperature is satisfying the supply air temperature setpoint. Took screen capture.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open but the supply air temperature is not increasing above the mixed air temperature.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S10-4-E (Upholstery)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-Th=5am-10pm; Fri=5am-4pm Sat=6am-4pm for a total of 89 hours/week. Will need to verify class schedule for actual occupancy of area. **ECO #27**
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive

- a. The chilled water valve is opening even though the mixed air temperature is satisfying the supply air temperature setpoint. Took screen capture.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-1-E (Auto Body Right Door Area)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open but the supply air temperature is not increasing above the mixed air temperature.
 - c. The BAS is indicating that this AHU shares the same schedule as S10-1-E but there is another schedule listed for this piece of equipment that could be set different than S10-1-E.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-2-E (Body Shop Paint Booth)

Finding Type Number (10/14/10): Note: Power OFF; unit would not start in “Auto” or “Hand”

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open when the status of the fan is OFF.
 - c. Fan does not run when command ON by the BAS.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-3-E (Back of Truck Maintenance)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.

- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open but the supply air temperature is not increasing above the mixed air temperature.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-4-E (Front of Truck Maintenance)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open but the supply air temperature is not increasing above the mixed air temperature.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-5-E (Back of Auto Mech)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The heating valve is modulating open when the mixed air/economizer control could regulate the supply air temperature to maintain the space temperature. Thus, if there is to offset of the setpoints between the mixed air temperature and the supply air temperature the heating valve would not need to open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-6-E (Back of Auto Mech???) Verify location. Not on BAS

S11-7-E (Night School Auto Mech)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The heating valve is modulating open when the mixed air/economizer control could regulate the supply air temperature to maintain the space temperature. Thus, if there is to offset of the setpoints between the mixed air temperature and the supply air temperature the heating valve would not need to open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-7-E (Dyno Room)

Finding Type Number (10/14/10):

6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The heating valve is modulating open when the mixed air/economizer control could regulate the supply air temperature to maintain the space temperature. Thus, if there is to offset of the setpoints between the mixed air temperature and the supply air temperature the heating valve would not need to open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve indicates 100% open when the status of the fan is OFF.
 - c. Fan does not run when command ON by the BAS.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-8-E (High School Auto Mech)

Finding Type Number (10/14/10):

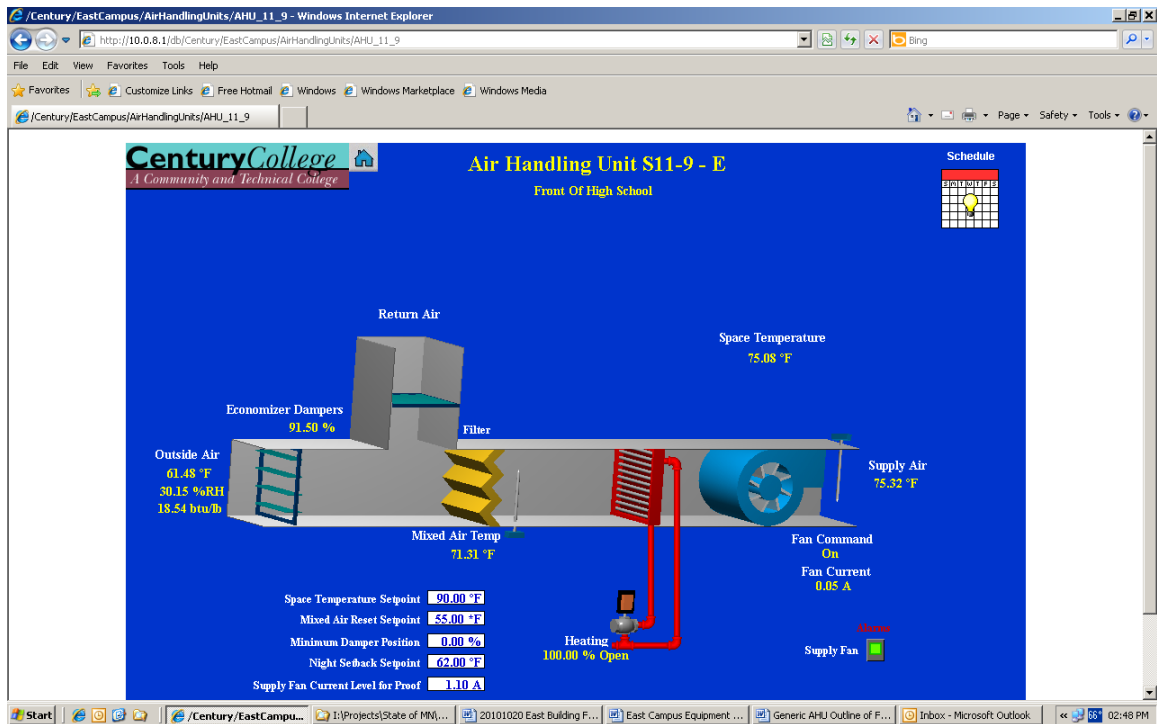
1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.

- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The heating valve is modulating open when the mixed air/economizer control could regulate the supply air temperature to maintain the space temperature. Thus, if there is to offset of the setpoints between the mixed air temperature and the supply air temperature the heating valve would not need to open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S11-9-E (Front of High School)

Finding Type Number (10/14/10):

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
- 8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. The heating valve is modulating open when the mixed air/economizer control could regulate the supply air temperature to maintain the space temperature. Thus, if there is to offset of the setpoints between the mixed air temperature and the supply air temperature the heating valve would not need to open.
- 11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
 - b. The heating valve does not open as commanded by the BAS. Took screen capture (see below)
- 40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.



S11-11-E (Upstairs 210D Heating Air)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. The damper indicates 100% open but the mixed air temperature is 63 degF with the OAT at 53 degF; the damper is opening properly. The outside air louver is extremely dirty and will not let outside air in for economizer control. Verified OA/RA damper do operate and are in correct position. Took picture.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.
46. Differed Maintenance from Recommended/Standard
 - a. The heating coil needs to be cleaned. Took Picture
 - b. A return air duct (background) was added but without separate damper, there will not be any air drawn from the duct but all from the louver.
47. Impurity/Contamination
 - a. Verify air filter maintenance. The air filters are extremely dirty – Took Picture.
48. Other Maintenance
 - a. The outside air louver is extremely dirty and will not let outside air in for economizer control. Verified OA/RA damper do operate and are in correct position. Took picture.

S12-W (Kitchen)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Could not access equipment schedule because of access rights to UHL software; verify with Jim Tjossem.
11. Control Problems: Other
 - a. AHU shut off at disconnect?
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S12-1-E (Kitchen)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 5am – 6pm for a total of 65 hours/week. Will need to verify class schedule for actual occupancy of area.
11. Control Problems: Other
 - a. AHU shut off at disconnect?
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S12-2-E (Kitchen) Name on the PBEEEP documentation is S12-E

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Could not access equipment schedule because of access rights to UHL software; verify with Jim Tjossem.
11. Control Problems: Other
 - a. AHU shut off at disconnect?
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

AHU E (Facility Repairs Upstairs)

Finding Type Number (10/27/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 7pm for a total of 75 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.

S13-1-E (Upper Graphics Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week. Will need to verify class schedule for actual occupancy of area.
ECO #30
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - a. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.

S13-2-E (Lower Graphics Area)

Finding Type Number (10/14/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - b. The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week. Will need to verify class schedule for actual occupancy of area.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - b. Minimum outside air damper is set to 0% open.
11. Control Problems: Other
 - b. The minimum damper position is set to 0% open. Verify the minimum position on the plans; this should be equal to the exhaust fan quantity within that area served by the AHU and associated exhaust fan.
47. Impurity/Contamination
 - a. Heating Coil is dirty and needs to be cleaned. Took picture.

S14-2-E (Room 230D) being demolished and replaced with new.

S15-1-E (Front Welding)

Finding Type Number (10/14/10): Note: The motor disconnect trips when the fan is tried to start.

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
11. Control Problems: Other
 - a. Fan is commanded ON but the status is indicating OFF.
 - b. The heating valve is open when the fan is indicating OFF.
13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. No night setup/setback. Night setback is set to the same temperature as the daytime space temperature setpoints. See screen capture.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S15-2-E (Front Welding)

Finding Type Number (10/22/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
11. Control Problems: Other
 - a. The heating valve does not open when commanded by the BAS. Took screen capture below; the supply air temperature does not change as the valve position changes.
13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. No night setup/setback. Night setback is set to the same temperature as the daytime space temperature setpoints. See screen capture.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.



S16-1-E (Back Welding)

Finding Type Number (10/22/10): Note: Could not reach fan to verify face/bypass position (equipment in the way)

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. No night setup/setback. Night setback is set to 2 degF less than the daytime space temperature setpoints. See screen capture.
11. Control Problems: Other

- a. The heating valve is open when the BAS indicates closed. Supply air temperature at 88 degF when valve indicates closed. Took screen capture below.
40. Retrofit - Energy/Heat Recovery
- a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.



S16-2-E (Back Welding)

Finding Type Number (10/22/10): Note: Could not reach fan to verify face/bypass position (equipment in the way)

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-F 6am – 5pm for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. No night setup/setback. Night setback is set to the same temperature as the daytime space temperature setpoints. See screen capture.
11. Control Problems: Other
 - a. Locked out at motor disconnect.
40. Retrofit - Energy/Heat Recovery
 - a. Verify the exhaust in this area to evaluate the consideration of adding a heat recovery system.

S16-3-E (Back Welding)

Finding Type Number (10/22/10): Note: Equipment not on BAS and motor disconnect locked out and labeled not used.

S17-E (Ambulatory)

Finding Type Number(10/22/10):

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.

- a. The BAS schedule is listed at M-Th 5am – 9pm, Fri=5am – 4pm for a total of 75 hours/week. Will need to verify class schedule for actual occupancy of area.
- ECO #2.2**
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. The outside air damper minimum position is set to zero (0).
- 8. Control Problems: Simultaneous Heating and Cooling is present and excessive
 - a. There is currently no offset between the mixed air temperature setpoint and the supply air temperature setpoint. Therefore, the chilled water valve will open to reduce the supply air temperature even though outside air could be used for economizer cooling.
- 11. Control Problems: Other
 - a. The return air damper does not open when the outside air damper closes. The unit is being starved for air.
 - b. The unit has a face/bypass damper associated with the steam heating coil that is not in use. The steam valve does not open for freeze protection and utilize the face/bypass damper to regulate the supply air temperature.
- 13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. There is no setup/setback of space temperatures during unoccupied conditions.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. There is no reset of supply air temperatures based on the conditions in the space.
- 27. Other Equipment Efficiency/Load Reduction
 - a. Recommend installation of motion sensors in spaces that have intermittent occupancy to shut off lights and reduce the outside air requirement and space temperature setpoints.
 - b. Recommend installation of CO2 demand ventilation at each VAV box and reduce the outside air via AFMS monitoring.
- 48. Other Maintenance
 - a. No access panels to view actual damper position.

AHU-11-10 O&P Area Outline of Findings

Finding Type Number:

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-Th 6am – 6:30pm, Fri=6am – 6pm for a total of 62 hours/week. Will need to verify class schedule for actual occupancy of area.
- 6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
 - a. Outside air dampers are set to 0% for minimum outside air conditions.
 - b. The outside air AFMS are only sensing half of the outside air ductwork. This unit has four outside air duct intakes and only two are being monitored by the outside air AFMS.
- 11. Control Problems: Other
 - a. The outside air and supply air AFMS are reading zero cfm from the BAS.
- 13. Controls Setpoint Changes: Zone setpoint setup/setback are not implemented or are sub-optimal.
 - a. There is currently no setup/setback temperature for unoccupied conditions.
- 16. Controls Setpoint Changes: VAV Box Minimum Flow Setpoint is higher than necessary
 - a. Review for future.
- 17. Controls Setpoint Changes: Other
 - a.

- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. The reset is currently based on outside air temperature. Recommend using space temperatures for reset of supply air.
- 22. Controls Setpoint Changes: Other
 - a. Recommend reset of supply duct static pressure based on the current conditions of the VAV box flow rates.

RTU-1 (Southeast Wing) Outline of Findings

Finding Type Number:

- 1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. The BAS schedule is listed at M-Th 5am – 10pm, Fri=5am – 4pm for a total of 79 hours/week. Will need to verify class schedule for actual occupancy of area.
- 7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. The economizer enable/disable setpoint is 64 degF outside air temperature. This is when the economizer is disabled and the mechanical cooling is enabled. The setpoint could be adjusted upward to achieve additional economizer cooling.
- 14. Controls Setpoint Changes: Fan Speed Doesn't Vary Sufficiently
 - a. This unit is a constant volume unit with VAV boxes. The fan speed does not vary based on the flow requirements of the spaces. The minimum VAV box flow is zero cfm. Verify with hood the flow rates and where the supply air is going when no VAV boxes are calling for flow to meet the constant volume of the fan.
- 16. Controls Setpoint Changes: VAV Box Minimum Flow Setpoint is higher than necessary
 - a.
- 20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. The supply air temperature does not reset based on the space conditions. Recommend supply air reset.
- 28. Variable Frequency Drives (VFD): Retrofit – Fans
 - a. The supply fan speed does not vary based on the supply duct static pressure.
- 41. Retrofit – System Custom:
 - a. The cooling system for this RTU is a packaged DX. Calculate the possibility of replacing the chilled water coil and connecting to the existing campus chilled water system. Efficiency of the DX vs. the campus chilled water system.
- 46. Differed Maintenance from Recommended/Standard
 - a.
- 47. Impurity/Contamination
 - a.
- 48. Other Maintenance
 - a.

East Ramp Snow Melt System Outline of Findings

Finding Type Number:

- 2. Equipment Scheduling and Enabling: Equipment is enabled regardless of need, or such enabling is excessive:
 - a. The snow melt system is enabled any time the outside air temperature is less than 45 degF. There is no moisture sensor to help determine whether or not the system should be enabled. Recommend calculation of ECO for outside air temperatures of less than 34 degF when moisture is present.
- 17. Controls Setpoint Changes: Other

- a. Verify the temperature at which the heat exchanger can be regulated? Supply water vs. Return water temperatures and the maximum allowable temperature.

EF-2 (Serving 3352 Restrooms) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week.
Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-3 (Serving 3356 Hi Sch Cosmo) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 5am – 3pm, Fri=5am – 2:30pm for a total of 49.50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-4 (Serving 3371 Post Cosmo) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 5am – 3:30pm, Fri=5am – 2:30pm for a total of 51.50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-5 (Serving 3375 Post Cosmo) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 5am – 3:30pm, Fri=5am – 2:30pm for a total of 51.50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-9 (Serving 3604 Restrooms) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week.
Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling

When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-20 (Serving 3679 Workroom) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 5pm, Sat=6am – 4pm for a total of 70 hours/week.
Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-23 (Serving 2216 Restrooms) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week.
Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-24 (Serving 2233 Restrooms) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 10pm, Sat=6am – 4pm for a total of 95 hours/week.
Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-25 (Serving 1259 Daycare) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 5am – 10pm, for a total of 85 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-27 (Serving 1265 Laundry) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 5am – 5pm, Fri=5am – 4pm, for a total of 59 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-28 (Serving 1262 Laundry) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 5am – 5pm, Fri=5am – 4pm, for a total of 59 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-59 (Serving 1681 HS Auto Body Classroom) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 6am – 5pm, for a total of 55 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-60 (Serving 2683 HS Auto Body) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-Th 6am – 10pm, Fri=6am – 5:30pm, for a total of 75.50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-63 (Serving 1629 Diesel BO) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 6am – 10pm, for a total of 90 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-64 (Serving 1754 Kopp RR) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 7am – 10pm, Sat=7:30am-10pm for a total of 72.5 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-DENT (Serving 2677 Dental) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 6am – 4pm, for a total of 50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

EF-DA (Serving 2675 Dental) Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
The BAS schedule is listed at M-F 6am – 4pm, for a total of 50 hours/week. Will need to verify class schedule for actual occupancy of area.
4. Equipment Scheduling and Enabling: Other Equipment Scheduling/Enabling
 - a. When the EF schedule is running outside of the supply fan schedule, the building space pressure can be negative allowing unconditioned air to enter the building structure.

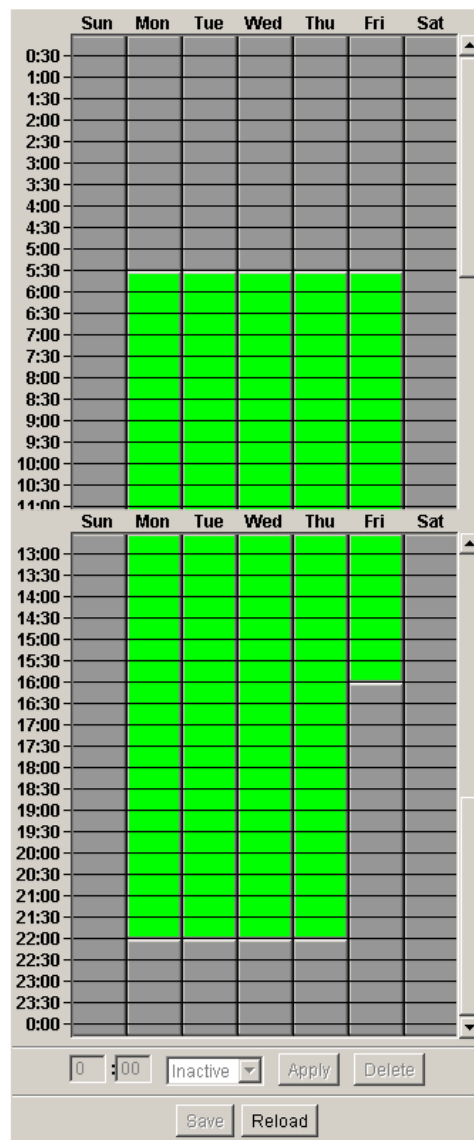
Kopp Center Outline of Findings

AHU-1 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took screen capture of schedule. Does not match actual building occupancy. The BAS schedule is 76.5 hours/week. Actual Schedule – M-Th-7am – 10pm F-7am-3:30pm and Sat-7:30am – 3:30pm for a total of 76.5 hours. The summer hours vary and closed during all school breaks; see website for closed hours. (Matching school occupancy schedule results in negative savings.)

Weekly Schedule: /Century/EastCampus/Schedules/Master_TechWing_AHU_Schd



5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
- The current economizer enable is 60 degF dry-bulb. Recommend 71 degF.
 - The current economizer enable is by dry-bulb temperature only. Recommend OA enthalpy and comparison of return air enthalpy and OA enthalpy for economizer enable.
6. Economizer Outside Air Loads: Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.
- Currently, the outside air damper is based on percentage of damper position. This is a VAV system with VFD control and OA AFMS monitoring. Recommend control of minimum damper position based on OA AFMS feedback.
9. Control Problems: Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement
- Recommend calibration of OA AFMS.
 - Recommend calibration of return air CO₂. Minimum CO₂ level at 750ppm.
11. Control Problems: Other
- Face/bypass damper do no open/closed completely.
 - Bypass damper blades are broken and do and close.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- Supply air temperature is not reset based on space load needs. Recommend reset based on space temperature. Currently based on return air temperature. (Resultant savings are not great enough for a justifiable ECO.)
22. Controls Setpoint Changes: Other
- Recommend duct static pressure setpoint reset. Currently setpoint is a constant at 1.30"wc even though there seems to be a High/Low duct pressure setpoint input.
47. Impurity/Contamination
- Verify air filter replacement schedule. Clean coils.

PAC Units (PAC-1 thru PAC-5) Outline of Findings

Finding Type Number:

49. Other

- a. Verify equipment space temperature setpoint requirements. Can the equipment take higher space temperature setting than currently installed?
- b. Verify equipment is set up for proper use with drycoolers.

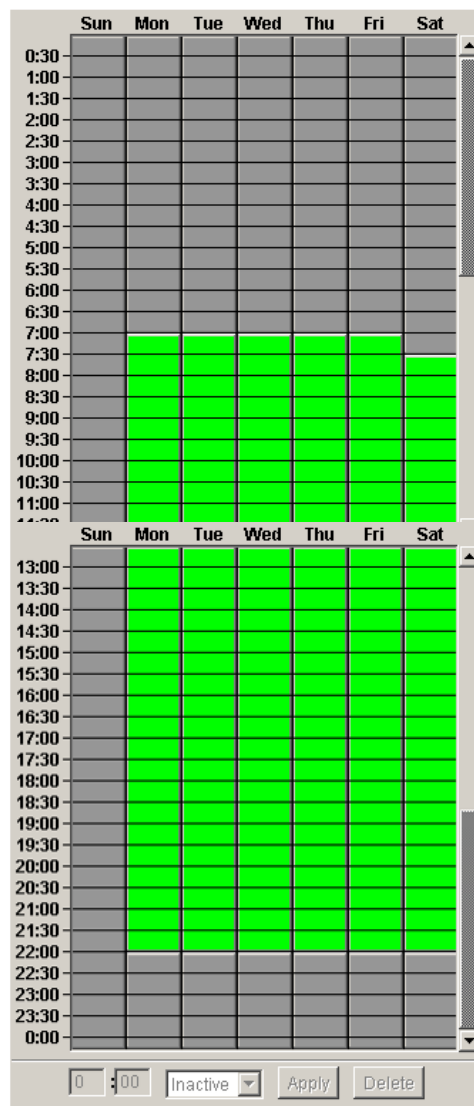
Exhaust Fan (EF-64) Serving Toilets Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.

- a. Took screen capture of schedule. Does not match actual building occupancy. The BAS schedule is 89.5 hours/week. (Resultant savings are not great enough for a justifiable ECO.)

Weekly Schedule: /Century/EastCampus/Schedules/EF_64_Schedule



Library/Science Building Investigation Checklist Notes

AHU-1

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took screen capture of schedule. Does not match actual building occupancy of Library Hours: M-F 7:30am - 9:00pm Sat 7:30am - 4:30pm Sun 9:00am - 3:00pm. The total weekly hours based on the Library Hours listed above are 82.5 hours/week. The scheduled equipment hours through the BAS are 84.5 hours/week.
7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Economizer enable/disable set at 55 degF – Recommend setting at 70 degF
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
11. Control Problems: Other
 - a. Recommend: Broadcast of chilled water or hot water availability from Physical Plant to restrict hot/chilled water valve and logic.
 - b. OA damper does not fully close.
 - c. Minimum outside air quantity set at 665 CFM – Verify actual design minimum.
 - d. OA AFMS reading 2700 cfm with OA damper closed/RA 100% open. Recommend calibration of OA AFMS.
 - e. Because of the building pressure issue, the relief damper is 100% open and the return air damper is 100% open, possibly allowing outside air to migrate through the relief duct. Recommend verifying control of OA quantity and calibrate supply AFMS and return AFMS. Also, program the return fan to lag the supply fan by the corrected OA quantity.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. Supply air temperature is not reset based on space load needs. Recommend reset based on space temperature.
22. Controls Setpoint Changes: Other
 - a. Recommend duct static pressure setpoint reset. Currently setpoint is a constant at 1.30"wc even though there seems to be a High/Low duct pressure setpoint input.
47. Impurity/Contamination
 - a. Verify AHU filter replacement periods and/or timelines. Clean coils.
49. Other
 - a. Optimal Startup from Night setback heating/cooling

AHU-2

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Took screen capture of schedule. Does not match actual building occupancy of Library Hours: M-F 7:30am - 9:00pm Sat 7:30am - 4:30pm Sun 9:00am - 3:00pm. The total weekly hours based on the Library Hours listed above are 82.5 hours/week. The scheduled equipment hours through the BAS are 84.5 hours/week.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
 - a. Currently the economizer lockout is 60 degF (auto setting is 55 degF) dry-bulb only.
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
7. Economizer Outside Air Loads: Other Economizer/OA Loads:
 - a. Because of the building pressure issue, the relief damper is 100% open and the return air damper is 100% open, possibly allowing outside air to migrate through the relief duct. Recommend verifying control of OA quantity and calibrate supply AFMS and

- return AFMS. Also, program the return fan to lag the supply fan by the corrected OA quantity.
9. Control Problems: Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement.
- a. The mixed air humidity sensor is reading 0%rh.
11. Control Problems: Other
- a. Minimum OA is set to 2500 cfm. Verify with design documents.
 - b. Because of the building pressure issue, the relief damper is 100% open and the return air damper is 100% open, possibly allowing outside air to migrate through the relief duct. Recommend verifying control of OA quantity and calibrate supply AFMS and return AFMS. Also, program the return fan to lag the supply fan by the corrected OA quantity.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- a. Currently there is not supply air temperature reset. The supply air setpoint is constant at 55 degF. Recommend reset based on local space temperatures.
47. Impurity/Contamination
- a. Verify AHU filter replacement periods and/or timelines. Coils need cleaning.
49. Other
- a. Optimal Startup from Night setback heating/cooling

AHU-3

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
- a. Verify classroom schedule. Compare to existing. Took screen shot of existing schedule.
5. Economizer Outside Air Loads: Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)
- a. Currently the economizer lockout is 60 degF (auto setting is 55 degF) dry-bulb only.
 - b. Recommend going to 70 degF with enthalpy controlled enable and return air enthalpy/outside air enthalpy comparison.
11. Control Problems: Other
- a. Recommend moving the MAT sensor from current location to after final filters (just before Heating/Cooling coil).
 - b. Recommend adding wheel supply air temperature sensor so that the delta-T across the wheel is known.
 - c. Recommend when the AHU is in economizer mode, the energy recovery wheel should be shut down and the OA bypass damper go to 100% open.
 - d. Recommend using the new mixed air sensor location to provide feed back for wheel speed.
 - e. The Exhaust fan is at minimum speed, what is controlling that exhaust fan? Because of the heat recovery wheel, the exhaust fan needs to match the flow of the outside air for greatest energy recovery.
 - f. The 1/3rd and 2/3rd heat/cool valves are open 100% and the DAT temperature is overshooting its setpoint. DAT 58.75 degF Setpoint 65.5 degF.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
- a. Currently there is not supply air temperature reset. The supply air setpoint is constant at 55 degF. Recommend reset based on local space temperatures.
47. Impurity/Contamination
- a. Verify AHU filter replacement periods and/or timelines. Clean coils.
48. Other Maintenance

- a. The supply fan has a vibration at 35 hz and at operating speed. Could be caused by the vibration isolation springs (fan inlet side springs) being collapsed at operating speed.
49. Other
- a. The supply fan is being starved of air.
 - b. When the economizer is disabled because of high OAT, the exhaust fan continues to run. Verify the control sequencing because this unit could shut down the exhaust fan because it is only used for heat exchanger flow. Recommend shutting down the EF if the economizer is disabled or the heat exchanger is not needed.
 - c. On the graphics page for the AHU, the selection for the CW/HW Return Temp trend log goes to the AHU-1 MaRH log.
 - d. Optimal Startup from Night setback heating/cooling

AHU-4 Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.
 - a. Verify class schedule with actual equipment schedule. In talking to the staff, most get of the facility at 7am to 10pm but some of the labs are not in use during the day or evenings. Review the ability to use the lighting occupancy sensor that is in each of the spaces. Need to obtain the class schedule for Biology and Chemistry.
9. Control Problems: Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement
 - a. The outside air AFMS is reading approximately half of the supply fan AFMS. This is a 100% outside air unit; the readings should be the same.
 - b. The graphics indicate two HR bypass dampers, there is only one bypass damper section located on the outside air section of the heat exchanger.
11. Control Problems: Other
 - a. AHU Graphics page indicates a bypass damper on EF-311. The damper has been blanked off and the controls are not installed. Recommend removing this damper from the graphics and any programming that is not in use.
20. Controls Setpoint Changes: Supply Air Temperature Reset is not implemented or is sub-optimal
 - a. Currently, there is no reset of supply air temperature based on load conditions. Recommend resetting SAT.
 - b. The space temperatures being used for possible reset include FTR. Recommend removing these space temperatures because each FTR has its own sensor and will bias the reset of the VAV boxes.
22. Controls Setpoint Changes: Other
 - a. Recommend that the frost control temperature be based on the return air dew point and not the dry-bulb temperature. This will allow additional heat exchange without frosting the heat exchanger. There is a fixed frost control temperature. The programming could be modified such that the existing RAT and RA RH could calculate the dew point and use that calculation for the new frost control setpoint. This is a maintenance item as it would be difficult to calculate an ECO.
27. Other Equipment Efficiency/Load Reduction
 - b. There is heat exchange going on with the outside air bypass damper open to bypass. The delta-T across the outside air is 5 degF and across the return air is 3 degF. Verify closure of outside air bypass dampers on the heat exchanger. The OA Bypass damper is working correctly. This can be removed from our findings documentation. What is happening is there is enough damper leakage and sensor placement to look like there is more leakage than actual.
47. Impurity/Contamination
 - a. Verify filter change schedule with Owner. Clean coils.
49. Other

- a. Optimal Startup from Night setback heating/cooling

Lighting Outline of Findings

Finding Type Number:

23. Daylighting Control needs optimization—Spaces are Over-Lit

- a. Library area has a lot of outside light available. Space lighting is on when could be shut down due to natural light by using a light harvesting sensor/controller.

Heating/Cooling System Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Equipment is enabled regardless of need, or such enabling is excessive:

- a. The heat/cool loop is enabled by schedule. During times when the campus physical plant is not providing chilled water or hot water to the system, the loop will be enabled. Recommend providing feedback from the physical plant indicating the primary loop temperature and not enabling the heat/cool loop until hot/chilled water is available for use.
- b. Also from note above. The heating/cooling requirements for each of the AHUs should provide feedback to the heat/cool loop controls to enable that system.

25. Over-Pumping:

- a. The chilled water flow requirements for each coil are much less than the hot water requirements; total chilled water flow of all coils is 511 gpm and total hot water flow is 133 gpm. Thus, during heating conditions, the hot water system could flow much more than required. The 1/3 valve should only be needed if the 1/3 valve gpm is the corrected hot water flow. Verify flow rates of each of the 1/3rd and 2/3rd valves.
- b. Heating/cooling system pumps are lead/standby. The control system allows the standby pump to start at 95% of lead pump speed. The standby pump continues to run until the pump speed drop to 55%. This is causing additional runtime on the standby pump.

49. Other

- a. The heat/cool loop GPM meter is reading ~560 gpm with AHU-1 valves open. AHU-1 valves are balanced to 120 gpm. Verify accuracy of GPM meter.

Boiler System Outline of Findings

Finding Type Number:

2. Equipment Scheduling and Enabling: Equipment is enabled regardless of need, or such enabling is excessive:

- a. The boiler that serves the radiation/reheat loop is enabled at an OAT of 60 degF. There are no space load requirements for heating to determine if the radiation/reheat coils are needed for heating. Recommend providing feedback from the radiation/reheats to determine if the hot water system should be enabled.

Miscellaneous Outline of Findings

Finding Type Number:

1. Equipment Scheduling and Enabling: Time of Day enabling is excessive.

- a. Verify EF master schedule is accurate to the occupancy schedule of the building.

49. Other

- a. FTR-314 as indicated on the DLR plans in stairwell 3877 is hot 24/7. No indication on the BAS for control.
- b. Third Floor Graphics – The selection for SAV-4312 brings up a graphics page representing that SAV with incomplete data.
- c. Third Floor Graphics – The selection for SAV-4314 brings up SAV-4312.
- d. EF-308 – The BAS is commanded the fan to run but the fan is not running.
- e. The EF graphics page indicates that EF-304 serves 2880, it actually serves 2868.
- f. AHUs – Currently, during cooling mode the 1/3rd valve opens first and then the 2/3rd valve. Verify the flow rates of the 1/3rd and 2/3rd valves because these could be used as a heating valve (1/3rd) and a cooling valve (2/3rd).
- g. VAV-2204 – The reheat valve indicates 0% open but the DAT at the VAV indicates 94 degF.
- h. VAV-2207 – The CFM max/min actual (500/225) design is 250/100.
- i. VAV Boxes w/ Radiation – What is the OA lockout for use of radiation?
- j. VAV-2111 – Serving Coffee Shop – Relocate space temperature sensor away for equipment influence. Recalculate cooling load requirements for air flow.
- k. Domestic Water Booster Pump – Pump #1 of the set should be looked at for repair. Bearing may be going.
- l. SAV/EAV – The face velocity readings on the graphics pages do not match those at the hood. Took screen capture.
- m. SAV/EAV – The flow rates are higher than needed. In the above screen capture, all of the sashes are closed on the hoods but the flow rates on the graphics pages are in the 500 cfm plus ranges. Recommend verifying calibration of hoods and representation of information on graphics pages.
- n. EAV-4305 – The flow reading on the graphics page is 0cfm. There is flow through the hood and it is not in an alarm condition.
- o. SAV/EAV – The occupied and unoccupied space temperature setpoints are missing on some of the graphics pages.
- p. SAV/EAV – Verify if the fume hoods have any unoccupied face velocity setting. In some cases the fume hood face velocity setting can be reduced during unoccupied times.
- q. SAV/EAV – There is currently lighting occupancy sensors. Recommend using these sensors to initiate SAV/EAV setpoint and air flow changes based on the actual occupancy of the spaces.

PBEEEP

State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR MnSCU - Century College



04/06/10

Summary Table

Facility Name	Century College
Location	3300 Century Ave N, White Bear Lake, MN 55110
Facility Manager	Jim Tjossem
Number of Buildings	23 (By State ID #'s); 5 for Report
Interior Square Footage	723,455
PBEEEP Provider	Center for Energy and Environment
Date Visited	1/19/2010, 2/18/2010
Site Project Manager	Ron Fields
Annual Energy Cost	\$940,791
Utility Company	Xcel Energy (electricity and natural gas)
Site Energy Use Index (EUI)	104.4 kBtu/sq. ft
Benchmark EUI (from B3)	156.8 kBtu/sq. ft (from B3)

Recommendation:

A detailed investigation of the energy usage and energy savings opportunities of the thirteen buildings listed below totaling 677,031 interior square feet at Century College is recommended at this time.

Building Name	State ID	Building Group	Area (Square Feet)	Year Built
Phase I Bldg B	E26154C0168	West	97,097	1968
Phase II Bldg E	E26154C0269	West	26,672	1969
Phase III Bldg A	E26154C0371	West	29,740	1971
Phase IV Bldg C	E26154C0474	West	32,166	1974
Phase V Bldg D	E26154C0577	West	47,564	1977
Addition Bldg K	E26154C0690	West	2,494	1990
Addition Bldg F	E26154C0790	West	13,224	1990
Addition Bldg J	E26154C0890	West	11,150	1990
Kopp Technology Center	E26154C0903		22,600	2003
Library/Science Building	E26210----		66,930	2008
Main Building	E26210T0171	East	303,539	1971
South Add	E26210T0574	East	20,839	1974
Auto Part Add	E26210T0676	East	3,016	1976

Century College Screening Overview

The goal of screening is to identify buildings where an in-depth energy investigation can be performed to identify energy saving opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of the site was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. Two walk-throughs were conducted on 1/19/2010 and 2/18/2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and its potential for recommissioning. This report is the result of that information.

The site is made up of two campuses, West Campus and East Campus, each of which contains a number of buildings. The West Campus is composed of eight interconnected buildings totaling 260,107 interior square feet. The East Campus is composed of one main building with three additions totaling 329,794 interior square feet. The East Campus is attached by enclosed hallways to the Kopp Center, 22,600 interior square feet, and the Library/Science Building, 66,390 interior square feet. There are eleven detached satellite buildings on the site that total 48,946 interior square feet. The total building count is twenty-four, with 728,377 interior square feet. There is a single automation system (UHL) which controls the large buildings on both campuses, but none of the satellite buildings. The controls are DDC, but the actuation is pneumatic except for the Library/Science Building and the Kopp Center which are digital. There is also a dedicated Trane Trace System for the chillers. The buildings were all constructed between 1968 and 2008. There have not been any major mechanical upgrades during the history of the facility except for AHU-6 and -7 that are being upgraded at the present time (winter 2009-2010). These two units should not be included in the energy investigation since they are under warranty.

Overall, there are 64 air handlers, 2 chillers, 8 chilled water pumps, and over 20 hot water pumps. Unit heaters are used in several satellite buildings which do not receive heat directly from AHUs (Greenhouse heated by unit heaters; Service Station heated by residential furnaces) as well as in a small addition to the Warehouse on the East Campus.

There are five electric meters and eight natural gas meters at Century College. Any further sub-metering is not necessary since the meters are split between the major buildings and uses.

Reasons for Recommendations

There are many factors that are part of the decision to recommend a building for investigation at Century College, the following characteristics were important in the building selection process. The buildings recommended for investigation have:

- Large contiguous square footage
- Direct connection to the building automation system
- Energy intensive uses (e.g., greenhouse, shop areas)
- Occupancy schedules that vary in the facility

The buildings not recommended for investigation are

- Small (averaging under 5,000 square feet) and
- Very little equipment is controlled by the building automation system.

The buildings are divided into three categories in this report: those that are recommended for energy investigation; those that were considered, but not recommended; and those that were poor candidates for investigation.

Recommended for Investigation:

The two campus building groups (West Campus and East Campus), the Kopp Center, and the Library/Science Building, totaling 679,431 ft² are good candidates for investigation. Each of these buildings has a large floor area, several air handling units, and is controlled by the building automation system.

Central Plant (Located in East Campus Building Group) State ID# E26210T0171

- Chiller Plant

Chiller 1	2003	500 Ton	
Chiller 2	2003	500 Ton	
Cooling Tower	2003	40 hp pump	2X 30 hp fans (VFD)
Secondary Loop	1996	3 x 20 hp pumps (VFD)	
Pumps	1971	3 x 1000 GPM	

Chiller plant runs when it is warm outside. Manual start and stop.

- Boiler Plant

Boiler Cleaver Brooks	1971	25,106 kBtu/h	Low Pressure Steam. Has high turndown burner
Boiler Cleaver Brooks	1971	25,106 kBtu/h	Low Pressure Steam. Does not have high turndown burner.
Heat Exchanger	2005		Convert Steam to HW for West building
Secondary Loop Pumps (HDP1-3)		3 x 20 hp (VFD) 3 x 1000GPM	Pumping to West Campus. Control to DP. Runs 2 at a time.

The boiler plant runs from October through May.

Points on BAS

- General: All of the large equipment is controlled by the BAS. Most of the terminal equipment is too; whatever is not controlled is monitored. The system is a UHL Company system and is serviced by UHL. Points on BAS: OAT, OARH, OA-Enthalpy, Photocell Status, Light Switch,
- Chiller Plant: ON/OFF. Trane Tracer-Summit System controls the chillers. Full access to the chiller monitoring points through Tracer system. Statuses, all temperatures, Chiller Load %, Temperature setpoints,
- HW System: Boiler Status, Pump Status, Tertiary Pump Statuses, Tertiary Loop Temperature, Tertiary Loop Temperature set point, Flow Switch, HWS-T, HWR-T, System DP, Pump HDP1-3 Status, HDP1-3 VFD Speed, Steam 1/3-Valve Position, Steam 2/3-Valve Position, HW System Enable OAT Setpoint, HWS-T set point, HW DP set point.

East Campus Building Group			State ID #	E26210T0171 E26210T0574 E26210T0676	
Area (sqft)	329,893	Year Built	1971-2003	Occupancy (hrs/yr)	4,200
HVAC Equipment					
● 39 AHUs					
Name	Type	Size	Notes		
AHU S1	Dual Duct CV	12,153 cfm*, 30hp			
AHU S2	Dual Duct CV	15,832 cfm*, 25hp			
AHU S3	Dual Duct CV	20,232 cfm*, 30hp			
AHU S4	Dual Duct CV	29,263 cfm*, 40hp			
AHU S5	Dual Duct CV	26,187 cfm*, 40hp			
AHU S6	Dual Duct CV	12,588 cfm*, 30hp			
AHU S7	Dual Duct CV	22,982 cfm*, 40hp			
AHU S8	Dual Duct CV	15,918 cfm*, 25hp			
S9-1-E	Constant Volume	3,900 cfm, 1.5hp	Heat only		
S9-2-E	Constant Volume	3,900 cfm, 1.5hp	Heat only		
S9-3-E	Constant Volume	3,900 cfm, 1.5hp	Heat only		
S9-4-E	Constant Volume	3,900 cfm, 1.5hp	Heat only		
S9-5-E	Constant Volume	3,900 cfm, 1.5hp	Heat only		
S10-1-E	Constant Volume	5,250 cfm, 2hp	Heat only		
S10-2-E	Constant Volume	5,250 cfm, 2hp	Heat only		
S10-3-E	Constant Volume	5,250 cfm, 2hp	Heat only		
S10-4-E	Constant Volume	5,250 cfm, 2hp	Heat and Cool		
S11-1-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-2-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-3-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-4-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-5-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-7-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-8-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-9-E	Constant Volume	7,800 cfm, 3hp	Heat only		
S11-11-E	Constant Volume	7,800 cfm, 3hp	Heat only		
* = Measured Airflow from study date 6/6/07. Otherwise Design flow					

East Campus Building Group (continued)

Name	Type	Size	Notes
S12-1-E	FBP CV MUA	7,719 cfm*	Heat only
S13-1-E	Constant Volume	3,477 cfm*, 5hp	Heat and Cool
S13-2-E	Constant Volume	2,918 cfm*, 5hp	Heat and Cool
S14-2-E	Constant Volume	2,964 cfm*, 3hp	Heat and Cool
S15-1-E	FBP CV MUA	7,000 cfm, 2hp	Heat only
S15-2-E	FBP CV MUA	7,000 cfm, 2hp	Heat only
S16-1-E	FBP CV MUA	10,000 cfm, 2hp	Heat only
S16-2-E	FBP CV MUA	10,000 cfm, 2hp	Heat only
S17-E	VAV	4,500 cfm	Heat and Cool. Has 3 VAVs
AHU 12E	FBP CV MUA	7,719 cfm	Heat only
AHU 12W	FBP CV MUA	7,719 cfm	Heat only
AHU E	Constant Volume		Heat and Cool
RTU-1-E	Constant Volume	18,300 cfm, 20hp	Cool only

*= Measured Airflow. Otherwise design flow

- 74 Exhaust Fans**

Auto - Post Hi #9	EF-12	EF-27	EF-42	EF-57
Auto Repair #10	EF-13	EF-28	EF-43	EF-58
Auto Repair #11	EF-14	EF-29	EF-44	EF-59
Auto/Dyno	EF-15	EF-30	EF-45	EF-60
EF-1	EF-16	EF-31	EF-46	EF-61
EF-2	EF-17	EF-32	EF-47	EF-62
EF-3	EF-18	EF-33	EF-48	EF-AD1
EF-4	EF-19	EF-34	EF-49	EF-H1
EF-5	EF-20	EF-35	EF-50	EF-H2
EF-6	EF-21	EF-36	EF-51	EF-H3
EF-7	EF-22	EF-37	EF-52	Welding #1
EF-8	EF-23	EF-38	EF-53	Welding #2
EF-9	EF-24	EF-39	EF-54	Welding #3
EF-10	EF-25	EF-40	EF-55	Welding #4
EF-11	EF-26	EF-41	EF-56	

- The Boiler and Chiller Plants are also located in this building. They are listed separately at the top of the Building Listings as Central Plant.**

East Campus Building Group (continued)

Points on BAS

• AHU:

Name	List of Points	Notes
AHU S1-S8	Supply Fan Status, Speed, and Current, Return Fan Status, Speed, and Current, Heating Coil Valve, Cooling Coil Valve, Hot Deck Temp and set point, Cold Deck Temp and set point, MAT, OA Damper Pos, Return Air Damper Pos, Relief Damper Pos, RAT, RARH, RA-Enth, 3 Zone temps, Min Damper Pos, Night Setback Temp, Schedule, Morning Warm-up set point,	Note on BAS: "Leave VFDs at 58% for SF and 50% for RF for best pneumatic control. Verified 1.25"wg measurement in duct." 8 Identical Units
S9-1-4 E S10-1-3 E S11-1-5 E S11-7-9 E S11-11-E	Supply Fan Status and Current, Heating Coil Valve, DAT and setpoint, MAT and setpoint, OA Damper Pos, Zone temp, Night Setback Temp, Schedule	17 Identical Units
S16-1-2 E S15-1-2 E S12-1-E S12E S12W	Supply Fan Status and Current, Heating Coil Valve, DAT and setpoint, MAT and setpoint, OA Damper Pos, Zone temp, Night Setback Temp, Schedule	7 Identical Units
S13-1-2 E S14-2 E AHU E S10-4-E	Supply Fan Status and Current, Heating Coil Valve, Cooling Coil Valve, DAT and setpoint, MAT and setpoint, OA Damper Pos, Zone temp, Night Setback Temp, Schedule	5 Identical Units
S17-E	Supply Fan Status and Speed, Return Fan Status and Speed, Heating Coil Valve, Cooling Coil Valve, DAT and setpoint, MAT and setpoint, OA Damper Pos and min pos., Duct Static Pressure and setpoint, 3 Zone temps, Night Setback Temp, Schedule VAV Boxes: Flows (min, max, setpoint, present), Room Temp, Heating set point, Cooling set point, Valve Position	
RTU-1-E	Supply Fan Status and Current, Cooling Stages Active (1-4), DAT and setpoint, MAT and setpoint, OA Damper Pos and min pos., Zone temp, Night Setback Temp, Schedule	

• Exhaust Fan:

	Command On/OFF, Schedule	75 Identical Units
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West Campus Building Group State Building ID#

E26154C0168, E26154C0269, E26154C0371, E26154C0474, E26154C0577, E26154C0690,
E26154C0790, E26154C0890, E26154C0903

Area (sqft)	260,107	Year Built	1968-1990	Occupancy (hrs/yr)	4,200
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HVAC Equipment

• 21 AHUs

Name	Type	Size	Notes
AHU F1	VAV	15,500 cfm, 15hp	Heating and Cooling
AHU F2	VAV	11,800 cfm, 15hp	Heating and Cooling
AHU J1	VAV	21,000 cfm ⁺ , 20hp	Heating and Cooling
AHU K1	VAV	3,800 cfm ⁺ , 5hp	Heating and Cooling
AHU 1	Constant Volume	11,240 cfm ⁺ , 10hp	Cooling only
AHU 2	Constant Volume	10,237 cfm*, 20hp	Cooling only
AHU 3	Constant Volume	19,440 cfm, 20hp	Cooling only
AHU 4	Constant Volume	14,453 cfm*, 15hp	Cooling only
AHU 5	Constant Volume	4,104 cfm*, 5hp	Cooling only
AHU 6	VAV	New units	Under Construction
AHU 7	VAV	New units	Under Construction
AHU 9	Constant Volume	21,275 cfm ⁺ , 30hp	Cooling only
AHU 10	Constant Volume	6,460 cfm*, 7.5hp	Cooling only
AHU 11	Constant Volume	4,584 cfm*, 10hp	Cooling only
AHU 15	Constant Volume	12,416 cfm*, 25hp	Heating and Cooling
AHU 16	Constant Volume	12,475 cfm, 15hp	Cooling only
AHU 17	Constant Volume	19,420 cfm ⁺ , 25hp	Cooling only
AHU 18	Multizone	5,668 cfm*, 5hp	Heating and Cooling
AHU 19	Multizone	25,672 cfm*, 20hp	Heating and Cooling
AHU 20	Constant Volume	33,453 cfm*, 30hp	Heating and Cooling
AHU 21	Multizone	21,470 cfm ⁺ , 20hp	Heating and Cooling

+ = Design Values. Measured value found questionable in study dated 6/6/07.

* = Measured Values found in study dated 6/6/07

• 1 Boiler

	High Eff. Condensing.	2,000 kBtu/h	Fulton Pulse Boiler. Used in summer.
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• 28 Exhaust Fans

EF-2	EF-B ROOF-6	EF-C ROOF-1	EF-J ROOF-J4
EF-A ROOF-1	EF-B ROOF-7	EF-C ROOF-2	EF-J ROOF-J5
EF-A ROOF-2	EF-B ROOF-8	EF-C ROOF-3	EF-K ROOF-1
EF-B ROOF-1	EF-B ROOF-9	EF-D ROOF-1	EF-M-5
EF-B ROOF-2	EF-B ROOF-10	EF-D ROOF-2	EF-M-6
EF-B ROOF-3	EF-B ROOF-11	EF-D ROOF-3	EF-RM 2100-36
EF-B ROOF-4	EF-B ROOF-12	EF-D ROOF-4	EF-RM 2011-J1

West Campus Building Group (continued)

Points on BAS

• AHUs

Name	List of Points	Notes
AHU F1	DAT and set point, Duct Static Pressure and set point, Supply Fan Status and Speed, Cooling Coil Valve Pos, MAT and set point, OA Damper Pos, Relief Damper Pos, RAT, RARH, Morning warm-up set point, HW Valve Modulation Mode, Schedule, Building Static Pressure and set point.	There is a Return Fan, but no points on BAS. There is also a Heating Coil, but no points.
AHU F2	DAT and set point, Duct Static Pressure and set point, Supply Fan Status and Speed, Cooling Coil Valve Pos, MAT and set point, OA Damper Pos, Relief Damper Pos, RAT, RARH, Morning warm-up set point, HW Valve Modulation Mode, Schedule, Building Static Pressure and set point, Zone Temp.	
AHU J1	DAT and set point, Duct Static Pressure and set point, Supply Fan Status and Speed, Cooling Coil Valve Pos, MAT and set point, OA Damper Pos, Relief Damper Pos, RAT, RARH, Morning warm-up set point, HW Valve Modulation Mode, Schedule.	There is a Return Fan, but no points on BAS. There is also a Heating Coil, but no points.
AHU K1	DAT and set point, Duct Static Pressure and set point, Supply Fan Status and Speed, Cooling Coil Valve Pos, MAT and set point, OA Damper Pos, Relief Damper Pos, RAT, RARH, Morning warm-up set point, HW Valve Modulation Mode, Schedule, Building Static Pressure and set point.	
AHU 2	Supply Fan Status and Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point	
AHU 3	Supply Fan Status and Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point, 1 Zone Temp	
AHU 4	Supply Fan Status and Current, Return Fan Status and Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point, 2 Zone Temps	
AHU 5	Supply Fan Status and Current, Cooling Coil Valve, Heating Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point, 1 Zone Temp	
AHU 6	New unit*	Under Construction and warranty
AHU 7	New unit*	Under Construction and warranty
AHU 8, 9, 10	Supply Fan Status and Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point.	3 Identical Units

West Campus Building Group (continued)

Name	List of Points	Notes
AHU 11	DAT and set point, Fan Status and current, Cooling Coil Valve Pos, MAT, Damper Pos, RAT, Morning Warm-up set point, RAT set point, Min Damper Pos, Schedule	
AHU 15	Supply Fan Status, Speed, Current, Return Fan Status, Speed, Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Duct Static Pressure and set point, Morning Warm-up set point	
AHU 16	Supply Fan Status, Current, Return Fan Status, Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point, 2 Zone Temperatures	
AHU 17	Supply Fan Status, Current, Return Fan Current, Cooling Coil Valve, DAT, MAT, Damper Pos, RAT, Min Damper Pos, Schedule, DAT set point, Morning Warm-up set point, Zone Temperature	
AHU 18	Fan Status, Heating Coil run by reheat pump, Cooling Coil Valve, Hot Deck Temp, Cold Deck Temp, MAT and offset set point, Damper Pos, RAT, Zone temp, Min Damper Pos, Night Setback Temp, Schedule, DAT set point, Morning Warm-up set point	
AHU 19	Fan Status, Fan Current, Heating Coil is controlled by reheat pump, MAT, Damper Pos, RAT, DAT, Min Damper Pos, Night Setback Temp, Schedule, DAT set point	
AHU 20	DAT, Fan Status, Fan Current, Cooling Coil Reading (psi), Heating Coil Reading (psi), MAT, Damper Position, RAT, Winter/Summer Mode, DAT-set point, Min Damper Pos., Night Setback Temp, Morning Warm-up set point, Schedule, 3 room temperatures and setpoint	
AHU 21	Fan Status, Heating Coil Valve, Cooling Coil Valve, Hot Deck Temp and set point, Cold Deck Temp and set point, MAT and set point, Damper Pos, RAT, Zone temp, set point, and % Cooling (9 Zones), Min Damper Pos, Night Setback Temp, Schedule	

- Boiler:

Status, Mode, HWS-T and set point, HWR-T, 6 Radiation Zones HW-T and Valve position and set point, Boiler Modulation	Used in summer only.
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- AHU 6 & AHU 7 are under warranty and thus excluded from the energy investigation

Library/Science Building State Building ID# E26210---																																																												
Area (sqft)	66,930	Year Built	2008	Occupancy (hrs/yr)	4,200																																																							
HVAC Equipment																																																												
<ul style="list-style-type: none"> 4 AHUs <table border="1"> <thead> <tr> <th>Name</th> <th>Type</th> <th>Size</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>AHU-1</td> <td>VAV</td> <td></td> <td>Heating from main HW loop.</td> </tr> <tr> <td>AHU-2</td> <td>VAV</td> <td></td> <td>Heating from main HW loop.</td> </tr> <tr> <td>AHU-3</td> <td>VAV, with Enthalpy wheel</td> <td></td> <td>Heating from main HW loop.</td> </tr> <tr> <td>AHU-4</td> <td>VAV, 100 % OA</td> <td></td> <td>Heating from main HW loop.</td> </tr> </tbody> </table> 4 CRAC Units <table border="1"> <tbody> <tr> <td>PACU 101</td> <td>Liebert Cooling Unit</td> <td></td> <td></td> </tr> <tr> <td>PACU 102</td> <td>Liebert Cooling Unit</td> <td></td> <td></td> </tr> <tr> <td>PACU 103</td> <td>Liebert Cooling Unit</td> <td></td> <td></td> </tr> <tr> <td>PACU 104</td> <td>Liebert Cooling Unit</td> <td></td> <td></td> </tr> </tbody> </table> 1 Boiler <table border="1"> <tbody> <tr> <td></td> <td>Aerco Benchmark 2.0 Fully Condensing</td> <td>2,000 kBtu/h</td> <td>Used for the VAV reheats and radiation only.</td> </tr> </tbody> </table> 13 Exhaust Fans <table border="1"> <tbody> <tr> <td>EF 311</td> <td>EF 303</td> <td>EF 308</td> </tr> <tr> <td>EF 312</td> <td>EF 304</td> <td>EF 309</td> </tr> <tr> <td>EF 313</td> <td>EF 306</td> <td>EF 310</td> </tr> <tr> <td>EF 301</td> <td>EF 307</td> <td>EF 201</td> </tr> <tr> <td>EF 302</td> <td></td> <td></td> </tr> </tbody> </table> 						Name	Type	Size	Notes	AHU-1	VAV		Heating from main HW loop.	AHU-2	VAV		Heating from main HW loop.	AHU-3	VAV, with Enthalpy wheel		Heating from main HW loop.	AHU-4	VAV, 100 % OA		Heating from main HW loop.	PACU 101	Liebert Cooling Unit			PACU 102	Liebert Cooling Unit			PACU 103	Liebert Cooling Unit			PACU 104	Liebert Cooling Unit				Aerco Benchmark 2.0 Fully Condensing	2,000 kBtu/h	Used for the VAV reheats and radiation only.	EF 311	EF 303	EF 308	EF 312	EF 304	EF 309	EF 313	EF 306	EF 310	EF 301	EF 307	EF 201	EF 302		
Name	Type	Size	Notes																																																									
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EF 302																																																												

Library/Science Building (continued)

Points on BAS

- AHU:**

Name	List of Points	Notes
AHU-1, AHU-2	Supply Fan Status, Speed, cfm, Return Fan Status, Speed, cfm, DAT and set point, Duct Static Pressure and set point, Heating/Cooling Coil Valve position, HW/CHW leaving temp, 3 Damper positions, OA cfm, RAT, RARH, MAT, Min, Max, Avg Space Temp, RF Speed offset set point,	
AHU-3	Supply Fan Status, Speed, cfm, Exhaust Fan Status, Speed, DAT and set point, Duct Static Pressure and set point, Heating/Cooling Coil Valve position, HW/CHW leaving temp, 5 Damper positions (OA, EX, Return By-pass, OA By-pass, Return), OA cfm, RAT, RARH, MAT, Min, Max, Avg Space Temp, RF Speed offset set point, Enthalpy Wheel Status, Speed, Exhaust Temp,	
AHU-4	Supply Fan Status, Speed, cfm, Exhaust Fan Status, Speed, pressure, DAT and set point, Duct Static Pressure and set point, Heating/Cooling Coil Valve position, 3 Damper positions (OA, EX, HR By-pass), OA cfm, RAT, RARH, Min, Max, Avg Space Temp, Exhaust Temp,	

- CRAC:**

Name	List of Points	Notes
PACU 101-104	Status, Room Temp	

- Boiler:**

Name	List of Points	Notes
	Status and enable setpoint, HWS-T and setpoint, HWR-T, HW GPM, Pump Status nad speed, DP and setpoint,	

- Exhaust Fans:**

Name	List of Points	Notes
	Status, Schedule	

Kopp Center State ID# E26154C0903					
Area (sqft)	66,930	Year Built	2008	Occupancy (hrs/yr)	4,200
HVAC Equipment					
<ul style="list-style-type: none"> 1 AHU 					
Name	Type	Size	Notes		
AHU 1	Face and By-Pass VAV		Has 17 VAVs with reheat		
<ul style="list-style-type: none"> 5 CRAC Units 					
PACU_1	Liebert Cooling Unit				
PACU_2	Liebert Cooling Unit				
PACU_3	Liebert Cooling Unit				
PACU_4	Liebert Cooling Unit				
PACU_5	Liebert Cooling Unit				
<ul style="list-style-type: none"> 1 Exhaust Fan 					
EF-KOPP					
Points on BAS					
<ul style="list-style-type: none"> AHU: 					
Name	List of Points			Notes	
AHU 1	Supply Fan Status, Speed, cfm, and amps, Return Fan Status, Speed, and amps, DAT and set point, Duct Static Pressure and set point, Heating Coil Valve position, Hot Water Temperature, Cooling Stages Active (1-4), 5 Damper positions (OA, OA Primary, Exhaust, Exhaust Primary, Return), OA cfm, RAT, RA CO2, MAT, Min, Max, Avg Space Temp, RF Speed offset set point, Space Static Pressure and setpoint.				
<ul style="list-style-type: none"> VAV: 					
Name	List of Points			Notes	
	AHU DAT, Damper Position, Reheat Valve Position, Flow (min, max, setpoint, and current), North Perimeter boxes have radiation valve positions also.				

Consider for Investigation:

The Horticulture building, the four greenhouses and the East Maintenance building, totaling 20,694 ft² should be considered for investigation. While each of these buildings has a small floor area, no air handling units, and is not controlled by a building automation system, they all have high energy usage and thus offer potential for valuable savings. The screening information was collected from site visits, interviews, mechanical prints, and past energy studies. These additional attributes support the decision to consider the structures for recommissioning:

Greenhouse (4X) State ID# E26210T0776, E26210T1203, E26210T1303, E26210---					
Area (sqft)	8,615 (tot)	Year Built	1976-2007	Occupancy (hrs/yr)	
HVAC Equipment					
• Unit heaters					
Points on BAS					
• Unit heaters: 3 Zone temperatures					

Grounds Maint Bldg East State ID# E26210T0474					
Area (sqft)	2,976	Year Built	1974	Occupancy (hrs/yr)	2080
HVAC Equipment					
• Unit heaters					
Points on BAS					
• Unit heaters: None					

Warehouse Addition State ID# E26210T0884					
Area (sqft)	2,300	Year Built	1984	Occupancy (hrs/yr)	2080
HVAC Equipment					
• Unit heaters					
Points on BAS					
• Unit heaters: None					

Horticulture Building State ID# E26210T0371					
Area (sqft)	9,103	Year Built	1971	Occupancy (hrs/yr)	
HVAC Equipment					
• Boiler with baseboard radiation					
Points on BAS					
• Boiler supply water temperature, 3 Zone temperatures					

Poor Candidates for Investigation:

Two buildings, the Service Station, and the Unheated (Cold) Storage, totaling 6,172 ft² listed below are not good candidates for investigation. While the Horticulture Building has moderate floor area, it does not have air handling units, and are not controlled by the BAS. The screening information was collected from site visits, interviews, mechanical prints, and past energy studies. These additional attributes support the decision to recommend the facility for recommissioning:

- The remaining buildings are small (totaling 6,172 square feet)
- Very little equipment is controlled by the building automation system. The equipment that is has limited control points.
- There are few central HVAC systems (mainly remote equipment)

Service Station		State ID# E26210T0271			
Area (sqft)	1,372	Year Built	1971	Occupancy (hrs/yr)	
HVAC Equipment					
• Residential Furnaces					
Points on BAS					
• Residential Furnaces: None					

Unheated Storage		State ID# E26210----			
Area (sqft)	4,800	Year Built	2003	Occupancy (hrs/yr)	N/A
HVAC Equipment					
• None					
Points on BAS					
• None					

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	FCU	Fan Coil Unit
BAS	Building Automation System	HW	Hot Water
CAV	Constant Air Volume	HDP	Hot Water Differential Pressure
CDW	Condenser Water	HWR	Hot Water Return Temperature
CDWRT	Condenser Water Return Temperature	HWS	Hot Water Supply Temperature
CDWST	Condenser Water Supply Temperature	MA	Mixed Air
CFM	Cubic Feet per Minute	MAT	Mixed Air Temperature
CHW	Chilled Water	MAU	Make-up Air Unit
CHWRT	Chilled Water Return Temperature	OA	Outside Air
CHWST	Chilled Water Supply Temperature	OARH	Outside Air Relative Humidity
CRAC	Computer Room Air Conditioner	OAT	Outside Air Temperature
CV	Constant Volume	RA	Return Air
DA	Discharge Air	RAT	Return Air Temperature
DAT	Discharge Air Temperature	RF	Return Fan
DDC	Direct Digital Control	RH	Relative Humidity
DP	Differential Pressure	RTU	Rooftop Unit
DX	Direct Expansion	SF	Supply Fan
EA	Exhaust Air	Unocc	Unoccupied
Econ	Economizer	VAV	Variable Air Volume
EF	Exhaust Fan	VFD	Variable Frequency Drive
Enth	Enthalpy		